AUGUST, 1954

PIPE LINE INDUSTRY

CONSTRUCTION • OPERATIONS • MAINTENANCE

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What's Ahead...

for products lines?

a PIPE LINE INDUSTRY interview with HERBERT E. FISHER, president, Kaneb Pipe Line Company.....Page 36

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in communications?

an expert's predictions on what the future holds.....Page 52

See Page 3 for additional contents and a Quick Review of this issue

VAPOR PHASE COOLING

...is revolutionizing engine jacket cooling... page 44

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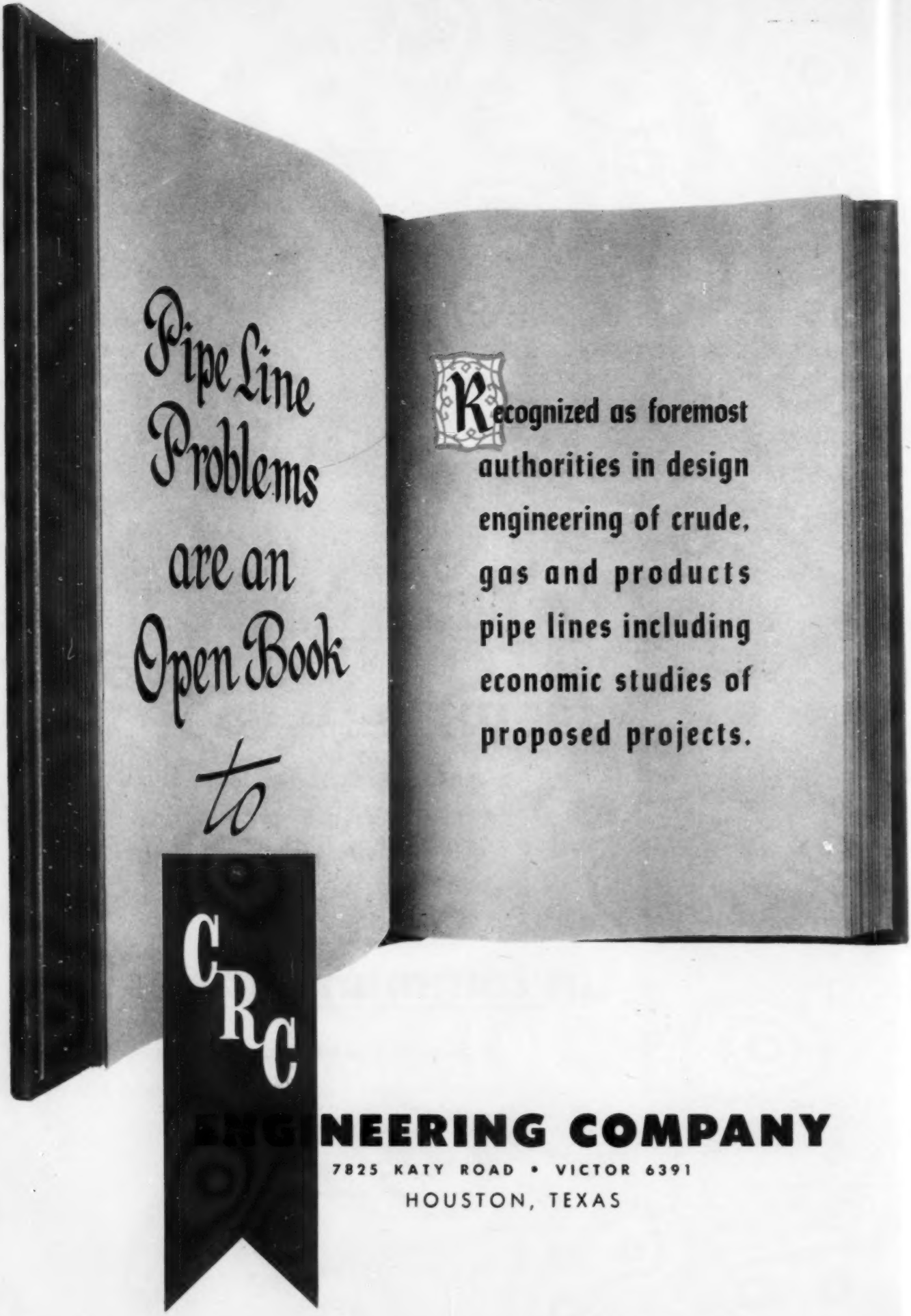
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HOUSTON, TEXAS

AUG -9 1954

PIPE LINE INDUSTRY

CONTENTS and Quick Review

August, 1954 Vol. 1, No. 2

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

What's Ahead for Products Pipe Lines?

☐ The future looks bright for products line expansion. Most bulk plants, airports, and perhaps many service stations will be served directly from pipe lines. Why? Under average conditions, small diameter products lines can transport gasoline for distances of ten miles or more cheaper than transport trucks. Page 36

What Employers Would Most Like to See in an Employe

☐ Are you a good employe? We asked nearly 300 executives to name the six qualities they would most like to see in those who work for them. Here is an article that may reveal how you measure up to your employer's standards.

By Al Reese.....Page 39

Engineers as Followers and Leaders

☐ A reexamination of the leadership facts of life shows there are three approaches that may be used in leading a group of engineers. They are autocratic leadership, democratic leadership, and free rein leadership. To learn what sort of leadership you exert and in what followership group you perform best, read this article and test yourself.

By Auren Uris.....Page 40

Vapor Phase Engine Cooling

☐ To eliminate variations in engine jacket temperatures, to eliminate circulating water pumps, to reduce engine wear and at the same time provide an inexpensive source of steam . . . use vapor phase engine cooling. It's a simple innovation. Its principle is to let the engine jacket water boil inside the jacket, thus taking advantage of the large heat of vaporization.

By Lloyd C. Harbert.....Page 44

What's Ahead in Communications?

☐ Here's a look at the future of petroleum communications through the eyes of an expert. Daniel E. Noble, vice president of the Communications and Electronics division of Motorola, Inc., points out new methods in radio wave propagation and reception that may enable you to transmit microwave over mountains and the earth's curvature up to 300 miles.

By Daniel E. Noble.....Page 52

How an Earthquake Affects a Pipe Line

☐ Here's the story of how Pacific Gas and Electric Company forces met the fury of one of California's worst earthquakes.

By R. J. Lind.....Page 56

Centrifugal Pump Relations and Characteristic Curves

☐ The relations between four variables make up "characteristics of the pump." The characteristics are: The capacity which varies from zero to some maximum value, the total head developed by the pump, the power required to drive it, and the resulting efficiency. Here's an article that will give you a better understanding of these variables.

By Roy Carter and Igor J. Karassik.....Page 62

Check for Orifice Meter Accuracy

☐ Here's a perennial problem and we've got the answers for you in pictorial form. With gas prices what they are today, measurement can stand some reexamination.

By W. R. Kehoe.....Page 67

Storing Propane in an Excavated Cavern

☐ More and more pipe lines are transporting LPG. Storage of large quantities in above-ground tankage is expensive and sometimes impractical. One company solved this problem by excavating a cavern in a limestone stratum 327 feet deep.

By J. W. Nixon.....Page 73

Cavitation vs. NPSH Requirements

☐ Serious difficulties from cavitation can often be eliminated by modifying NPSH requirements. The author shows the relationship between NPSH and cavitation and details a simple procedure for minimizing the cavitation problem. The effect of the type of liquid pump is shown graphically and these curves will become a part of your permanent files.

By L. H. Garnar.....Page 76

Harbor Crossing Designed to Settle 50 Feet

☐ Engineers figured Sarnia's Hamilton harbor crossing would settle indefinitely. So they laid the two lines with giant slack loops which would allow them to settle 50 feet. The same technique has been used recently on Mississippi River crossings.

By B. H. Mackenzie and P. T. Duff.....Page 80

Letters		35
Who's Meeting Where		35
You Asked About Corrosion	*Marshall E. Parker*	49
Rules of Thumb for the Pipeliner's Notebook		66
How to Do It—Pipe Line Hints		88
What's Happening in Pipe Line Construction		92
PIPE LINE INDUSTRY'S Views of the News		98
Pipe Line Men in the News		102
What's Happening Among Service and Supply Men		106
What's New in Equipment		108
ADVERTISERS' INDEX		112

Was He an S. O. B.?

"———— was an s.o.b., if there ever was one!"

The remark made several years ago, was about the head of a big institution that operated all over the U. S., and some other countries, too. The speaker was a man who was expressing an opinion which no doubt had been expressed by a lot of people, because the company head in question had probably personally fired more men than almost any other man occupying an equivalent position.

"He would rather fire a man than eat . . . why, over in Louisiana he . . ."

But *was* this man an s.o.b., or anything of the type of person whom we classify with such language?

No. As a matter of fact he wasn't. He was a man who liked his fellow man, who loved his family as much as you or I love ours.

He was tough as a boot, yes. Or rather he seemed to be.

•

I was with him at his home one night only a few years before he died. We sat out in the dark and talked about our jobs, what we liked about them and what we didn't like.

"I have a reputation of being a hard-boiled, tough 'un, without a conscience, without any warm blood in my body," he said. And privately I wondered if he really knew how bad his reputation was.

"But these people who say I am without a heart," he continued. "I wonder if they realize the kind of jobs I have been handed.

"First I was given the task of cleaning up a certain situation. It was plenty tough there. Thievery plus inefficiency were wrecking the operation. It looked like the company would have to pull out of the country. I was given the job of cleaning up. I did my best and it required the axe for a lot of persons. But I wonder if those who were left realized that they kept their jobs because the others had been fired.

•

"I guess that started my reputation. I was given a similar job in other areas where improvement in efficiency was necessary to keep things moving, and some employes had forgotten to be efficient. Maybe I made mistakes . . . I never knew a person who didn't make some . . . and now I am the cold blooded killer of men's hopes.

"Being made head of this company is not much recompense for what I have had to do to keep things on an even keel . . . but I wish there was some way for those who didn't lose their jobs to know that while I was firing other people I was protecting their jobs and the ability of their company to keep meeting a payroll."

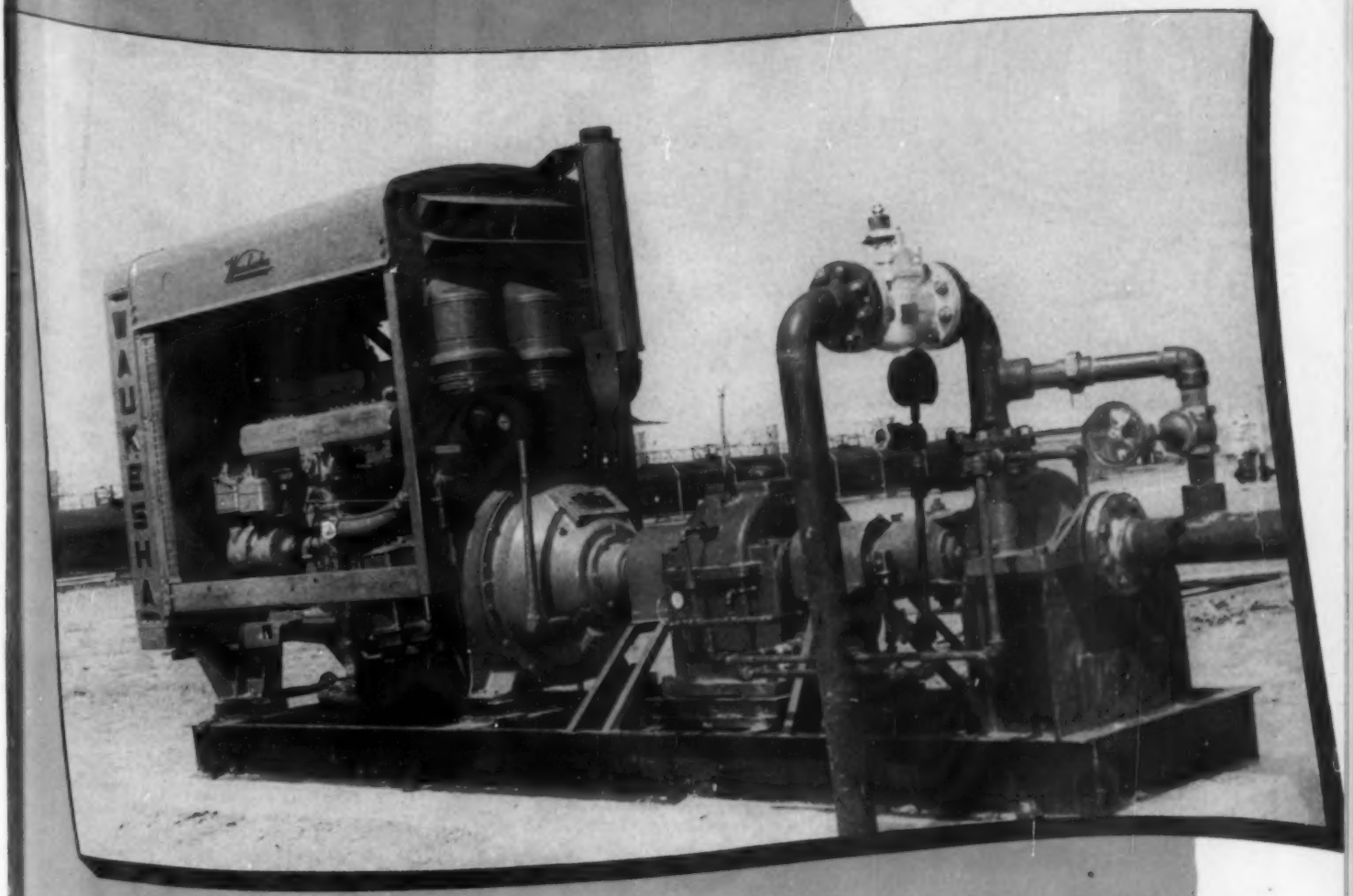
The man is dead now. But I wonder if some people didn't misjudge him.

What would the situation be on a ship if the captain didn't demand efficiency. What would the situation be in your company if somebody didn't have to do the unpleasant jobs as well as the pleasant ones.

Authority is fine . . . yes. It carries with it a lot of prerogatives. But it carries responsibilities, too. Maybe the boss doesn't have it so good, anyway!

Ray L. Dudley

Do YOU have an Underground Storage Problem?



...then you'll be interested in this application of WILSON-SNYDER Type ES Centrifugal Pumps

Near Ulysses, Kansas, engineers of the Stanolind Oil and Gas Company decided that the most practical way to secure underground storage facilities for petroleum products would be to dissolve and wash out existing salt formations.

The unit pictured above was installed to handle this "wash-out" operation.

It consists of a Wilson-Snyder 3 x 4 x 13 Type ES centrifugal pump, rated at 500 gpm for a 693 foot head (300 psi) at 3550 rpm.

The pump is driven by a Waukesha 6-WAKU engine, direct-connected through a speed-increaser.

The entire assembly is mounted on a skid base and can be moved from one location to another as the progressive stages of this operation may require.

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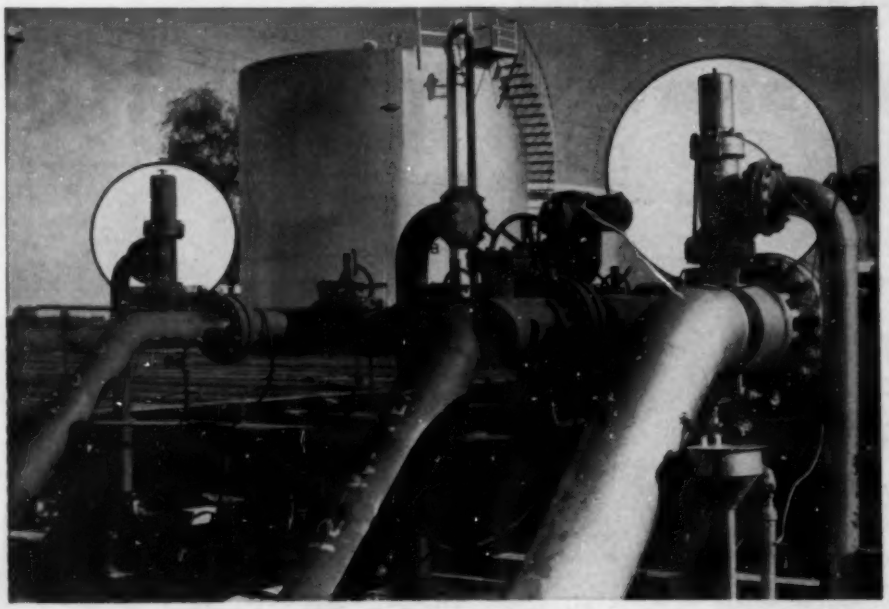
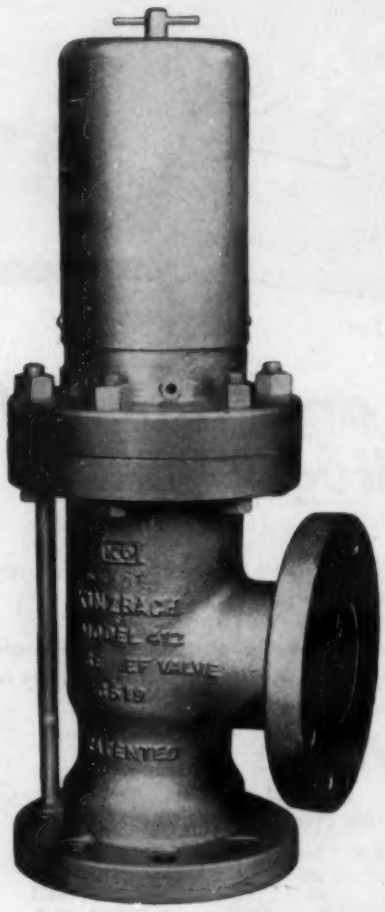


Positive Protection Against Pressure Surges



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PETROLEUM REFINER and **THE REFINERY CATALOG** for the refining-natural gasoline-petrochemical industry.

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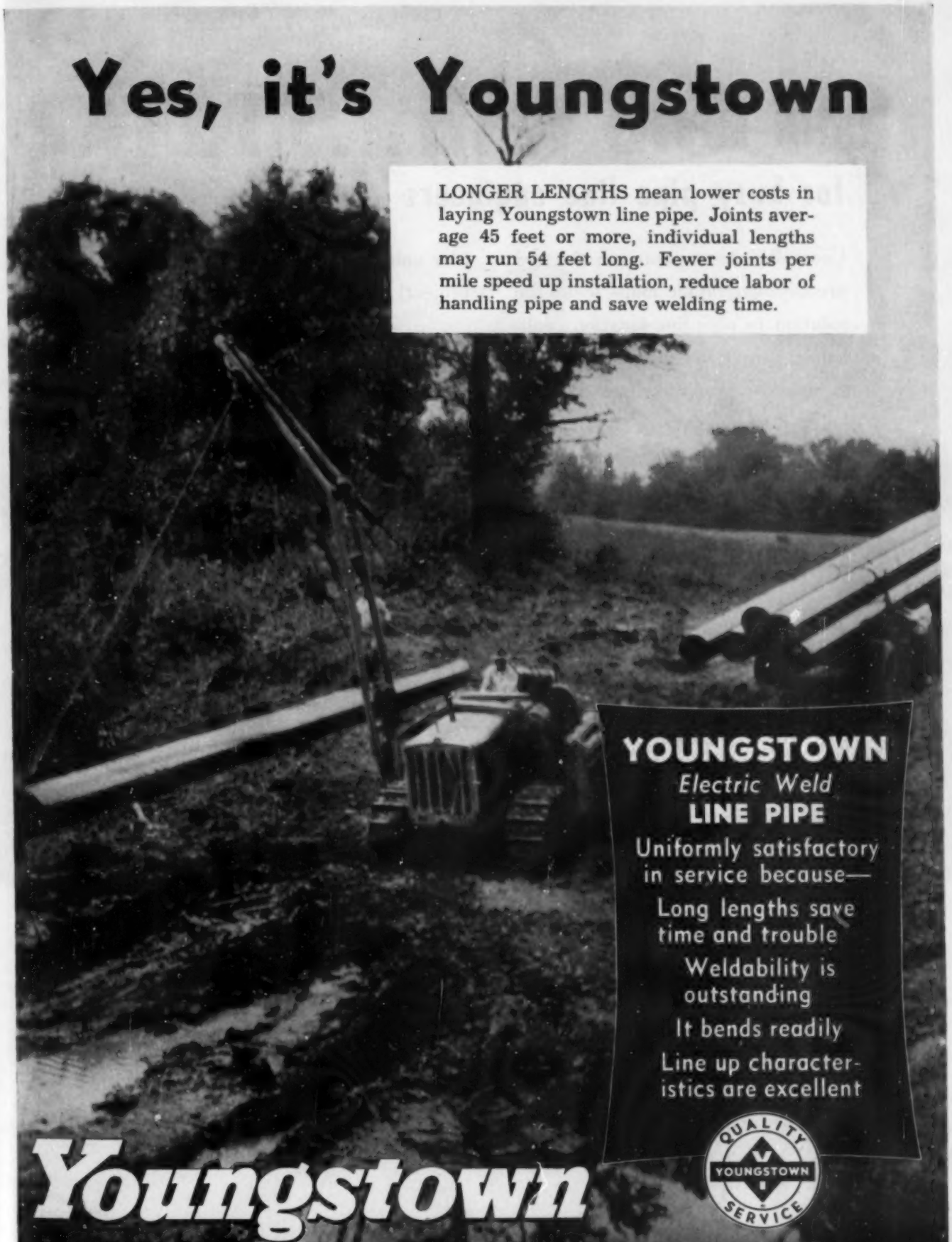
Yes, it's Youngstown



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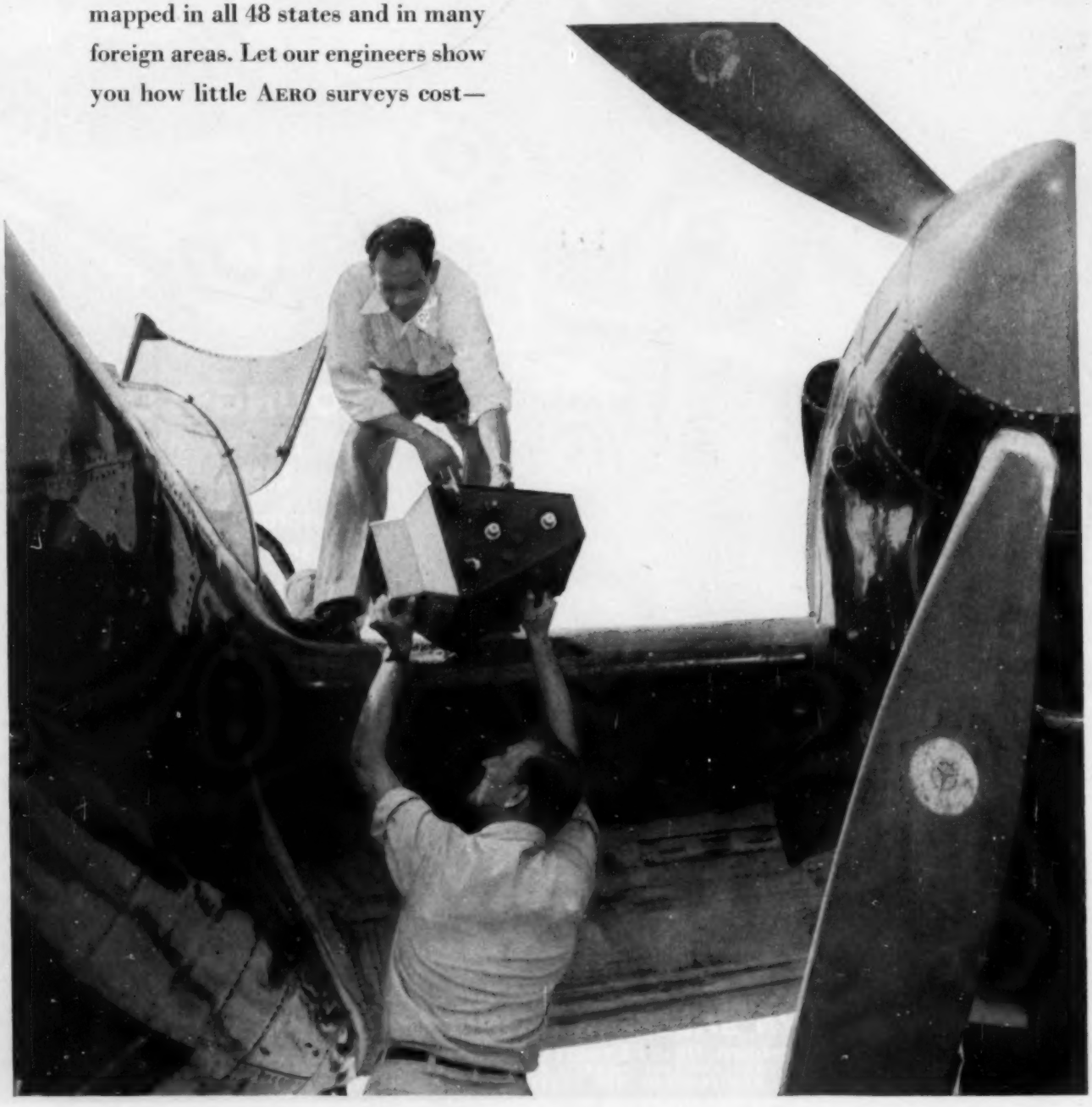

SAFETY...first and fast

This team of Caterpillar D8 Tractors with MD8 Pipe Layers is lowering in 26-inch gas line near Greenville, Miss. On another stretch near here these husky machines, which are owned by H. C. Price Co. of Bartlesville, Okla., crossed three-quarters of a mile of flooded rice field in only two hours. That was real speed, but it was made with full regard for the safety of the pipe-laying crew.

Accuracy of control is vital in this work. The Cat* MD8 Pipe Layer has separate brakes and clutches on both boom and load line drums. Conveniently placed operating controls and a special, heavy-duty Caterpillar transmission mean precise placement of the pipe—and "built-in" safety for the men on the job.

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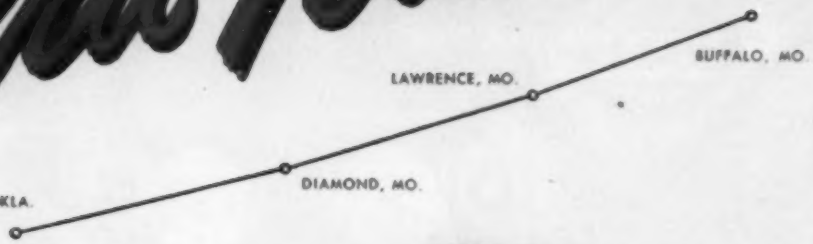

Pictured here is one of four modern stations on a major electric-powered pipe line boasting a total of 22,000 horsepower, and a 24-hour capacity of 340,000 barrels.

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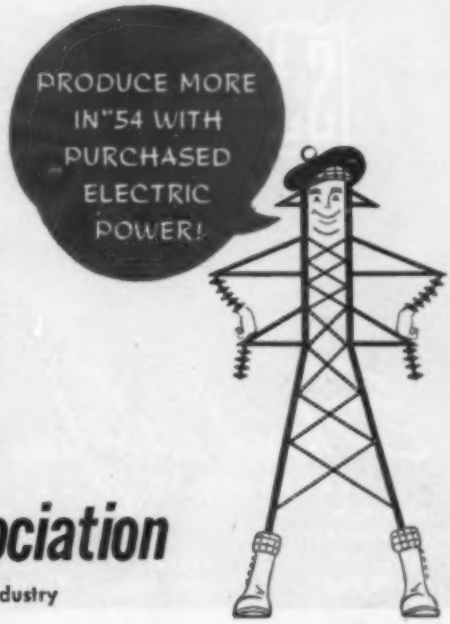

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At Corsicana, oil from East Texas, Oklahoma, West Texas and New Mexico will be pumped into the new line. Ultimately, capacity of the line can be increased to 165,000 barrels per day with new pumping equipment.

All the line pipe for this new line is from the Houston mills of A. O. Smith and Sheffield Steel . . . 20-inch welded steel pipe that's accurate as to size, roundness and end-to-end matchup. We are proud to have been able to supply Magnolia Pipe Line Company Texas-made pipe for this all Texas line.

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In Tuffy Rotary Lines is steel—high carbon steel specially patented for ultimate service. The number, the size of wires and lay of the rope and their pre-shaping around an independent wire rope core—all these features are special and different from any wire rope construction before used on rotary rigs.

Tuffy Jackknife Rotary Line is extra flexible for easy spooling and reeving on smaller sheaves of small jackknife rigs! Save rope costs, get extra ton miles of service, by switching to longer-lasting Tuffy Rotary Lines!

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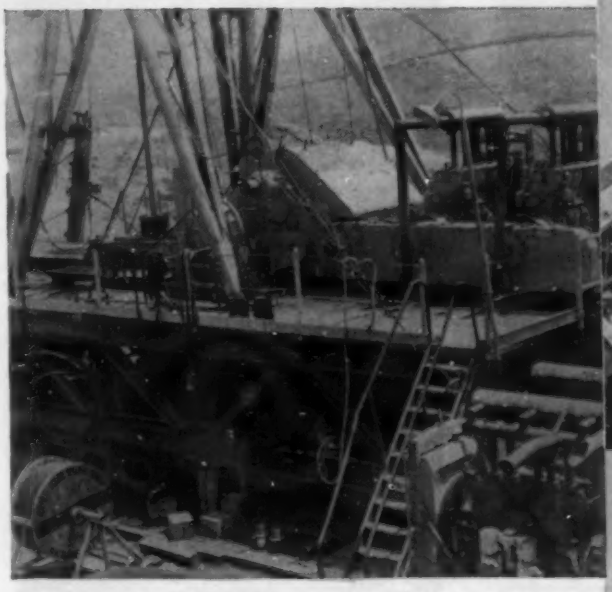
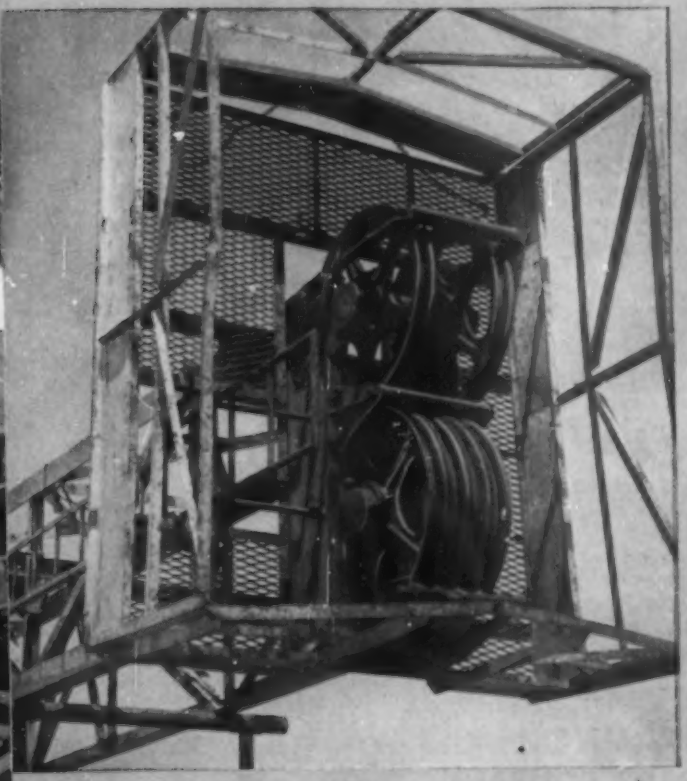
Rocky, abrasive formations make for tough drilling. Today, more and more drillers are switching to Tuffy Rotary Line because it gives them greater wearability. Particularly is this true at the three areas where line wear is toughest—on the drum at cross-over points, in the middle of the line where the blocks come up light against the sudden impact of the drill pipe load, and at the dead line sheave where all the energy of vibration is absorbed.



While Tuffy Jackknife Rotary Line is specially designed for use on rigs like this, Tuffy Standard should be used for deep drilling with a jackknife especially where large drill pipe with collars is handled in tribbles. It's specially constructed to resist drum crushing, vibration, shock loads and internal friction. Ask any toolpusher or rig operator who uses Tuffy Rotary Line, either Jackknife or Standard, and he'll tell you Tuffy pays off in *extra* ton mile service!



On small jackknife rigs, the smaller diameter of the sheaves calls for an extra flexible rope. Tuffy Jackknife Rotary Line is specially constructed with the flexibility needed for best possible spooling and reeving on jackknife sheaves and drums. Add to this the built-in super strength of Tuffy Jackknife Rotary Line, and it's easy to see why users report greatly increased service life when they switch to Tuffy Jackknife Rotary Lines!

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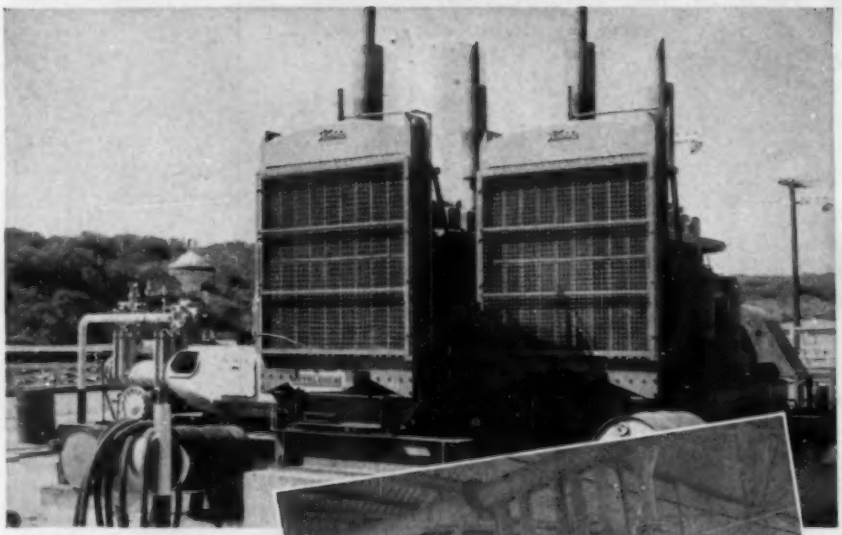

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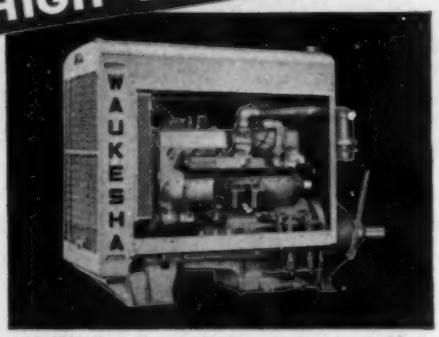
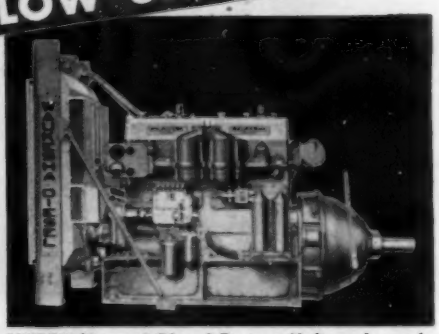
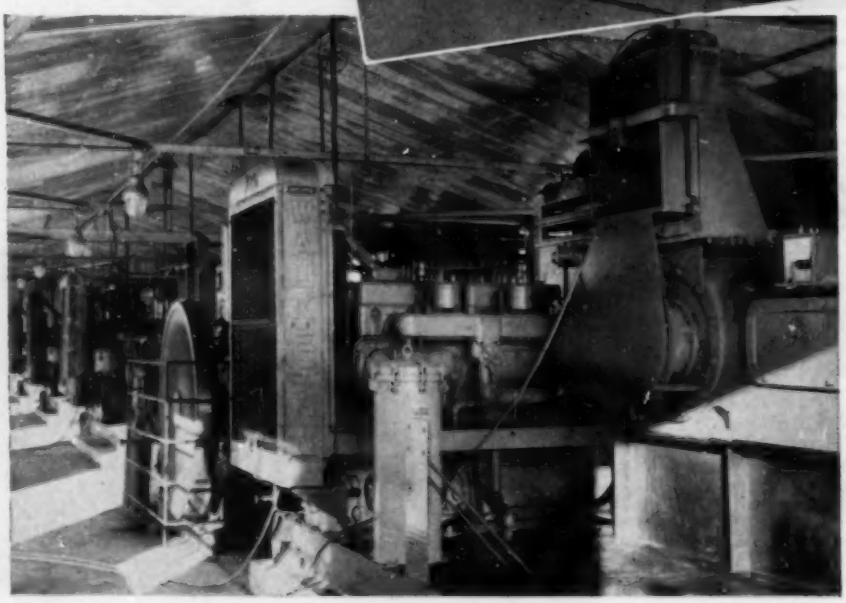


WAKBU Gas Power Unit—six cylinders, 6¼-in. bore x 6½-in. stroke, 1197 cu. in. displacement, 250 hp at 1800 rpm on natural gas.

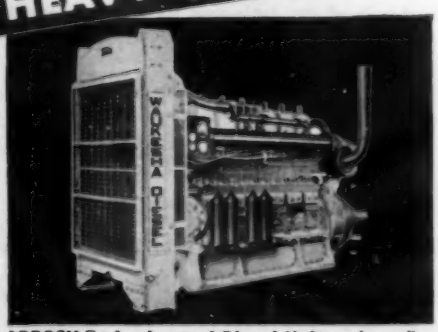
LOW UPKEEP



NKDBU Normal Diesel Power Unit—six cylinders, 7-in. bore x 8¼-in. stroke, 1905 cu. in. displacement, 274 hp at 1200 rpm, maximum.

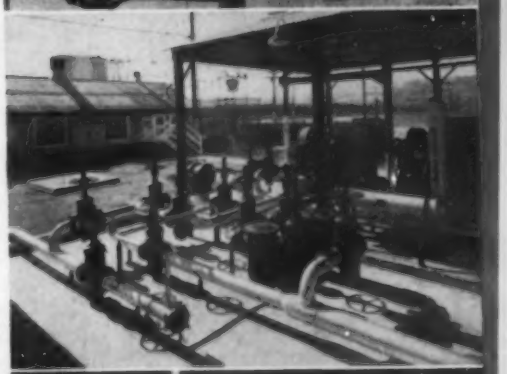


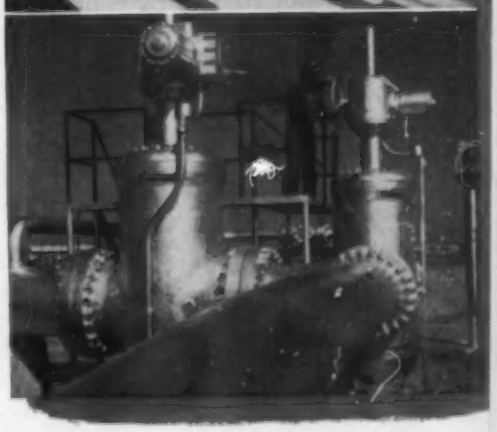
HEAVY DUTY



LRDBSU Turbocharged Diesel Unit—six cylinders, 8½-in. bore x 8½-in. stroke, 2894 cu. in. displacement, 526 hp at 1200 rpm, maximum.

NO MORE TURBULENCE . . .
NO MORE PRESSURE DROP
THROUGH HERE
THAN HERE





You get the same turbulence and the same pressure drop through a W-K-M Pipeline Valve as you get through a length of pipe the same I.D. and length as the valve conduit.

No Turbulence means a minimum of wear at the gate and seats — resulting in low or no maintenance cost involving these parts. **No pressure drop** means that the pump power is concentrated on the transmission of gas, oil and petroleum products, not wasted pushing it past obstructions.

W-K-M Valves offer more economies in maintenance costs and in efficient performance than any other pipeline valve — that's why Most of The World's Newest Pipelines are Tied Together with W-K-M Valves.

W-K-M Manufacturing Company, Inc.

A subsidiary of A.C.F. Industries Incorporated

P. O. Box 2117 Houston 1, Texas Los Angeles, California

Export Office: 30 Rockefeller Plaza, New York, N. Y.

W-K-M *Valves*

W-K-M Pipeline Valves have:

Full-Through-Conduit Flow • Positive Leverlock Gate Control

Pressure Seal Bonnet

Ball Bearing Operation • Superfinished Stems

BUCYRUS-ERIE 22-B DRAGSHOVELS OFFER

REAL WORK-ABILITY — Individual Design of the Bucyrus-Erie 22-B — as with every other model in the line — means that it is designed from the ground up to handle its rated load. There is no over-powering or over-dippering of one model to create another "new" model. Speed, power and weight are properly balanced. Rapid swing and hoist, together with a powerful digging stroke, mean more yards of trench every shift. Pin-point control eliminates handwork.

PLENTY OF TRACTION — With tractor-type treads, the 22-B dragshovel will move over soft or rough ground, up steep slopes. Deep grousers provide the bite to keep going.

MORE GROUND CLEARANCE—Tractor-type treads raise ground clearance on the 22-B dragshovel to 20¾-in. — enough to assure clearing of most obstructions along a right-of-way.

See your Bucyrus-Erie distributor soon for the full story on 22-B dragshovels for economical overall pipeline excavation. They're fully convertible in the field to crane, dragline, or shovel front ends. 18E54

SOUTH MILWAUKEE WISCONSIN

BUCYRUS ERIE

Fitting Insurance

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W.C. NORRIS, MANUFACTURER, INC.

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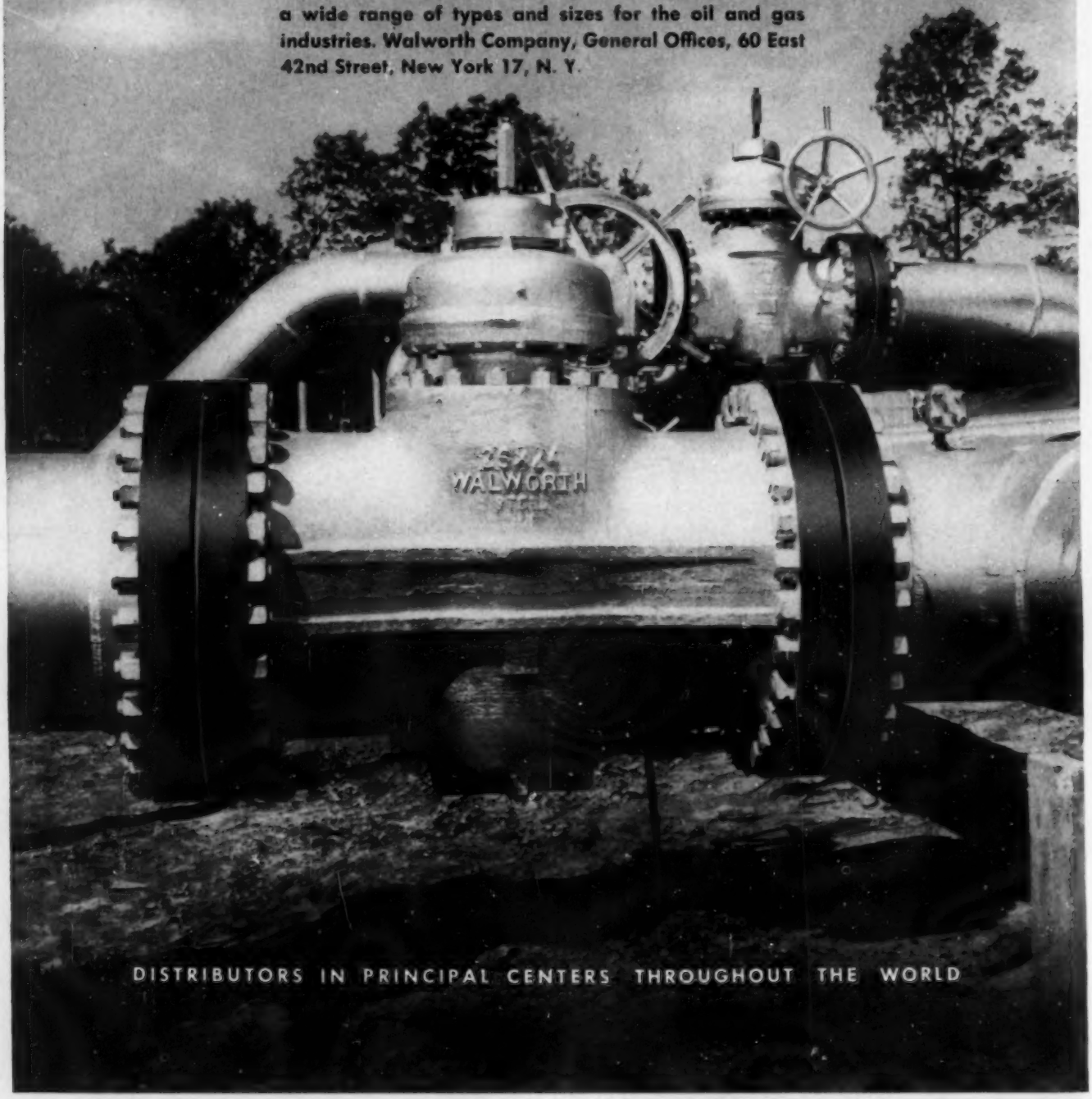
LUBRICATED PLUG VALVES by WALWORTH

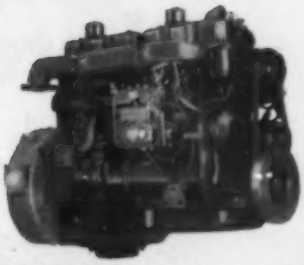
Two Walworth Cast Steel Lubricated Plug Valves in use on the main line of a southeastern gas pipeline.

In addition to Lubricated Plug Valves, Walworth manufactures Gate, Globe, Angle, and Check Valves in a wide range of types and sizes for the oil and gas industries. Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.



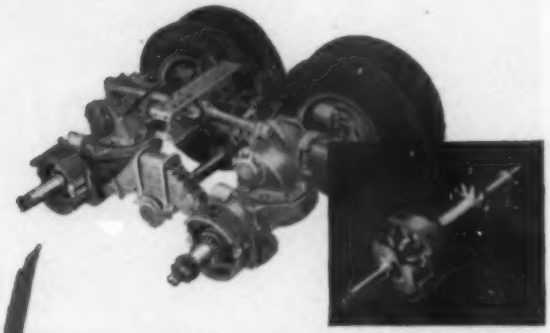
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

CHECK 'EM OFF



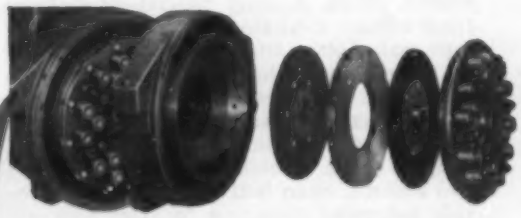
Plentiful Horsepower. Mack provides the right powerplant, gasoline or diesel, to haul most efficiently, most profitably for each specific operation. Complete range of engine options up to 400 horsepower. Coupled with the most rugged transmission or torque converters yet developed.

THE INSIDE REASONS FOR MACK'S STAND-OUT $$$ EARNING POWER

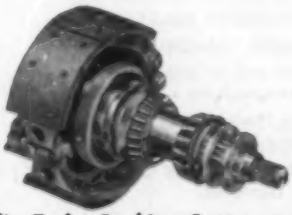


Balanced Bogie With Power-Divider. Only Mack six-wheelers offer the unique advantage of Mack's Balanced Bogie, incorporating the exclusive Power-Divider. With the Mack Power-Divider torque is distributed between bogie axles in proportion to traction, thus enabling Macks to pull through where other trucks mire in.

Power-Steering. Hydraulic power-steering permits effortless, fast steering and positive, shockless control.



Air-Assist Clutch. Operation of the big, double-plate clutch is virtually effortless, reduces driver fatigue.



Hydraulic Turbo-Braking Systems and powerful air-actuated brakes provide utmost safety for downhill going, assure safe and positive driver control at all times.

Keeping going under conditions that stop other trucks cold—carrying big payloads . . . on fast schedules . . . in the roughest operations—that's what points up the ability of Mack trucks to build greater profits for you.

WHEREVER YOU SEE A TOUGH JOB . . .
THERE IS WHERE YOU SEE MACKS

Mack Trucks, Empire State Building, New York 1, N.Y. Factory Branches and distributors in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

2277

there's a right Allis-Chalmers Tr

Here the HD-20 cradles pipe for doping operation

ALLIS-CHALMERS HD-20

- Hydraulic Torque Converter Drive
- Boom tractor with standard counterweights — 71,650 lb
- Bare tractor — 41,000 lb
- 175 net engine hp

Time and money-saving advantages like 1,000-hour lubrication periods for truck wheels, idlers, support rollers; oil-enclosed track release mechanism; all-welded box A-type main frame; true-dimension tracks give all three Allis-Chalmers side boom crawlers extra working hours, less down time. Extra long tracks and excellent balance provide stability and flotation to operate in mud and soft going. Double reduction final drives and smooth, clean bottom construction provide increased clearance to skim over obstacles that might otherwise hang up a tractor.

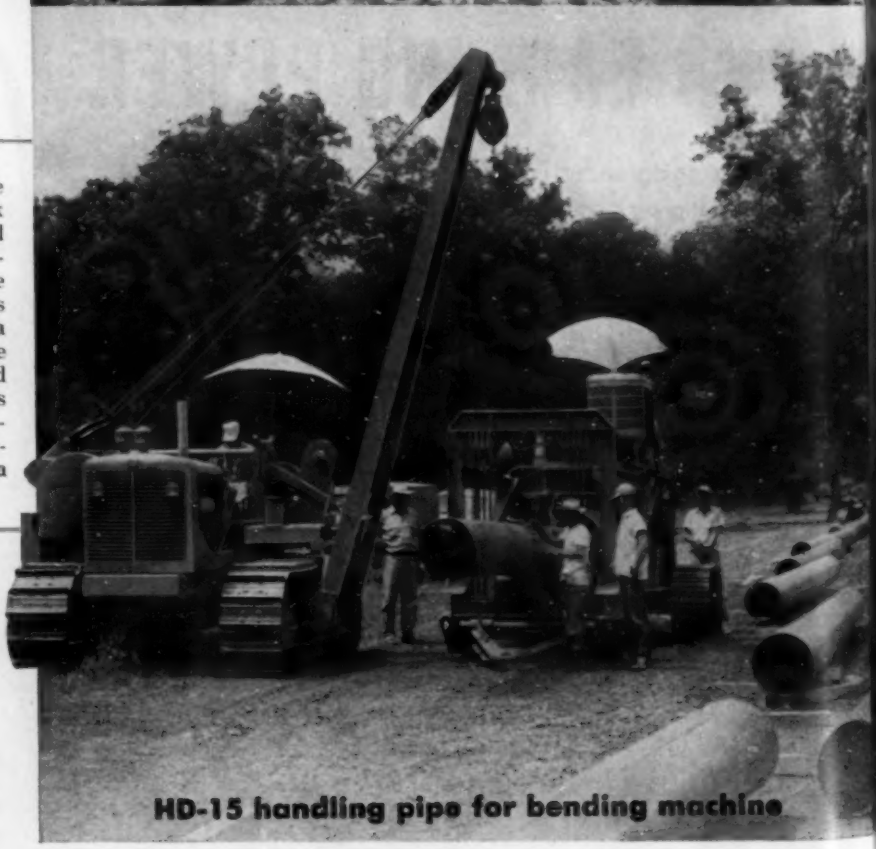
ALLIS-CHALMERS HD-15

STANDARD TRANSMISSION

- Boom tractor with standard counterweights — 50,050 lb
- Bare Tractor — 27,500 lb
- 109 drawbar hp

HYDRAULIC TORQUE CONVERTER DRIVE (optional)

- Boom tractor with standard counterweights — 50,500 lb
- Bare Tractor — 28,300 lb
- 135 net engine hp



HD-15 handling pipe for bending machine

Tractor-Side Boom Team for any size pipe, anywhere

Super inch, big inch, medium inch or small . . . whatever your pipeline job, there's an Allis-Chalmers tractor-side boom to handle it.

From dust bowls to swamp holes . . . in blistering deserts or windswept mountains, these modern, built-to-take-it tractors and matched side booms, provide work advantages that are boosting pipe footage, keeping tractor maintenance time and cost down.

Allis-Chalmers HD-20—20-ton powerhouse with liquid-smooth control

A big producer on all phases of pipeline work, the HD-20 is an outstanding favorite on cradling jobs. Here cushioned starts and steady control through built-in torque converter drive make it easy for operator to match tractor speed to cleaning-priming or doping-wrapping machines — even on steep hillsides. With torque converter eliminating most shifting, operator's hands are free to handle side boom controls.

Allis-Chalmers HD-15 — A standout before, does even more with torque converter drive

From the very first, the 27,500-lb HD-15 with standard gear transmission, performed beyond expectation on pipe laying, lifting, dozing and pulling jobs. Pipeliners are using it successfully on big and super-inch pipe previously handled by bigger, heavier machines. Now with optional hydraulic torque converter drive, it provides that precision control for cradling work plus greater forward speed, a faster reverse.

Allis-Chalmers HD-9—Right for smaller-inch pipe—a welcome addition on any job

This new, heavy-duty Allis-Chalmers HD-9 Tractor and side boom provides new strength, power and exceptional lifting capacity to handle a wide range of pipeline jobs. It's the right answer to construction of feeder, distribution and smaller-inch cross-country lines — ideal size on big-inch jobs for stringing, handling pipe for welders or bending machines — economical for maintenance, repair, and take-up on existing lines.

Check these side boom features

- Easy operating, convenient controls
- Completely enclosed internal expanding brakes
- Hydraulically controlled extendable counterweights
- Drop-proof counterweight linkage
- Quick-on, quick-off sectional frames
- Positive locking winch controls
- 2 forward and 2 reverse speeds for load line and boom line

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

SEE ALL THREE

Allis-Chalmers — originator of the torque converter tractor — and your dealer invite you to see any or all three of these advanced design tractor-side boom outfits — on your job. Make a date for a demonstration now.

HD-9 holding pipe for welding crews

ALLIS-CHALMERS HD-9

- Boom tractor with standard counterweights — 30,354 lb
- Bare tractor — 20,454 lb
- 72 drawbar hp

In its first year TCP...

the Greatest Gasoline Development in 31 Years... has re-powered 8 million engines

TCP*, the shell discovered additive, blended into Shell Premium Gasoline, controls pre-ignition and spark plug fouling caused by lead and carbon deposits. Increases power up to 15% ... spark plug life up to 150%

An entirely new gasoline, Shell Premium Gasoline with TCP, was first introduced to American motorists 12 months ago.

Because it overcomes the greatest cause of power and fuel loss affecting today's engines, it was hailed as the greatest fuel development since the introduction of tetraethyl lead in gasoline back in 1922.

In the first year following its announcement, Shell Premium with TCP has met with outstanding success. It has re-powered more than 8 million engines.

If you are not among the millions of motorists who are enjoying its benefits today, it will pay you to do so.

Shell Premium with TCP will increase the power of your engine up to 15%. It also prolongs the life of your spark plugs up to 150%.

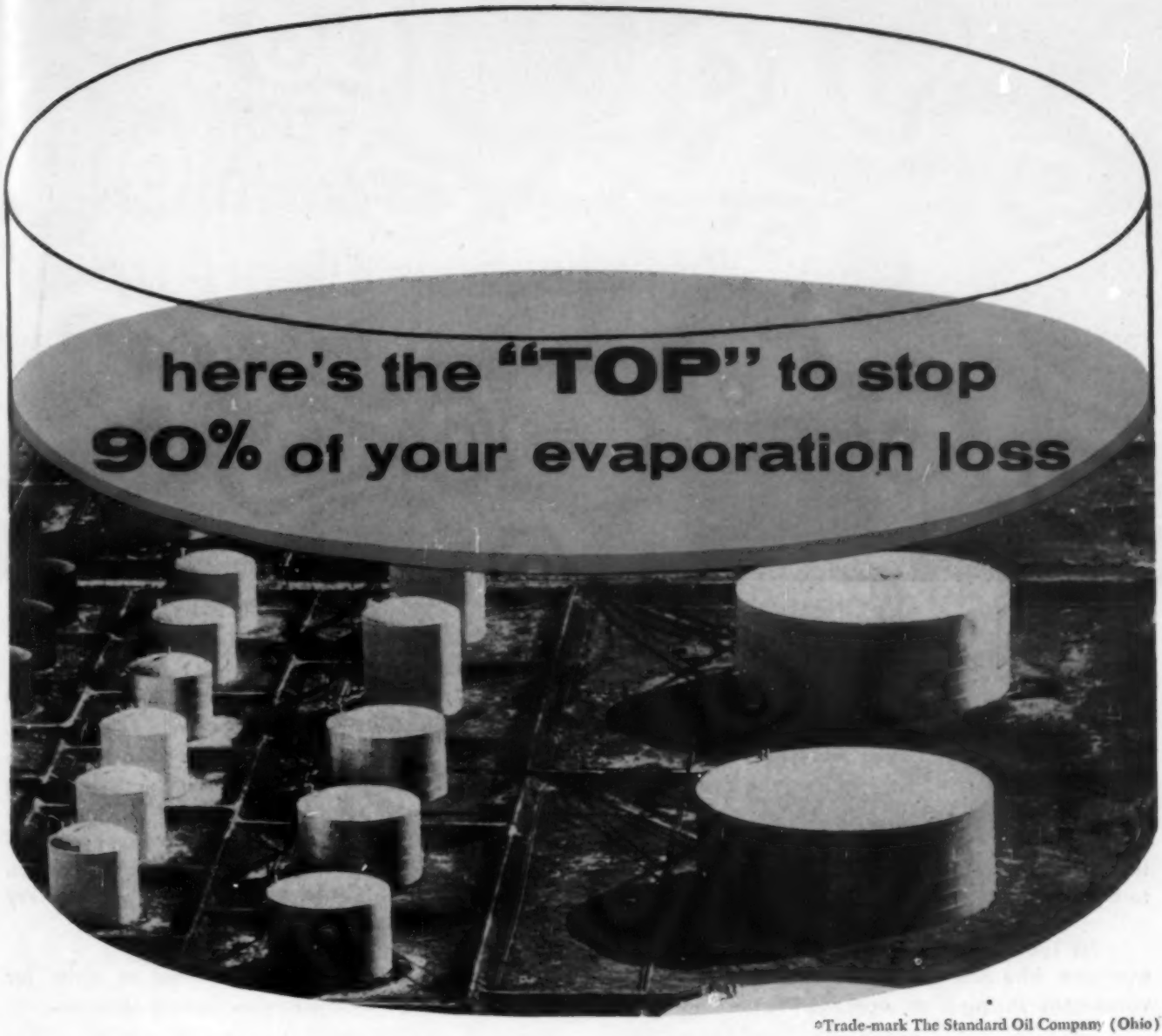
Shell Premium with TCP is an exclusive development of Shell Research and is available at all Shell Dealer Stations.

*TCP: the unique gasoline additive discovered by Shell Research. Only Shell and its authorized licensee, Continental Oil Company, have the full knowledge of the proper use of TCP additive. Trademark owned and patent applied for by Shell Oil Company.

SHELL

SHELL PREMIUM GASOLINE *with TCP*

The most powerful gasoline your car can use



*Trade-mark The Standard Oil Company (Ohio)

It's a half-inch layer of tiny, hollow Microballoon* spheres of BAKELITE Phenolic Resin that floats on the surface of crude oil. In an 88-ft. diameter tank it can prevent evaporation loss of more than 850 *barrels a year!*

These spheres lock in the original properties of crudes throughout long storage—keeping value up. And you save substantially on installation as compared with other volatile control systems. Initial cost is so low, oil savings alone can write it off in less than a year.

In application, the spheres—resembling reddish-brown flour—are pumped into the tank with the oil. Floating to the surface, they form a blanket that rises and falls with the oil level. It flows around internal supports, keeping the surface sealed as the level changes.

Tests show no deterioration in spheres floating on crude oil for over two years. Their small size and non-abrading qualities prevent damage to pipe lines and precision pumps.

Investigate these spheres for your tank facilities. Write Dept. YD-86 for illustrated booklet describing spheres made from BAKELITE Phenolic Resin for oil evaporation control.

BAKELITE
TRADE-MARK
PHENOLIC RESINS

TRADE MARK

BAKELITE COMPANY
A Division of
Union Carbide and Carbon Corporation
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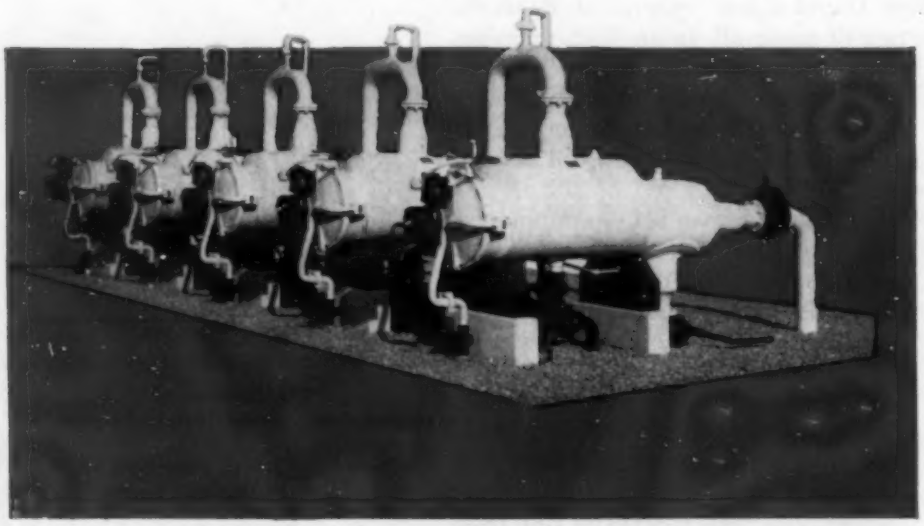
30 East 42nd Street, New York 17, N. Y.
In Canada: Bakelite Company
Division of Union Carbide Canada Limited
Belleville, Ontario

Pipeline Strainer "Clean-up Crew" at work

When a products pipeline strainer is needed most . . . immediately before a scraper arrives . . . you can depend on Thornhill-Craver Jet Type Fluid Strainers to **stay in there and pitch,** no matter how dirty the product may be. And you don't have to by-pass or back-wash with Jet Strainers in the line. Furthermore, there are no dirty, time-consuming strainer elements to be removed, cleaned, and reinstalled.

Jet Type Fluid Strainers are being acclaimed by everyone who has used them as a noteworthy advancement in pipeline operation. These strainers utilize a stainless steel wire cloth, of any desired mesh, spot-welded to a slotted stainless steel basket. When the basket needs cleaning, as indicated by a pressure differential gauge, it is subjected to high pressure flow through a series of jets mounted on a revolving head within the strainer. The entire cleaning operation requires only from three to five minutes. Stand-by strainers receive the flow while dirty strainers are being cleaned.

Interested operators are invited to write for complete details on these revolutionary strainers.



Jet Type Fluid Strainers

the only strainers that clean all the product all the time!

THORNHILL UNIBOLT **CRAVER CO.**

P. O. BOX 1184
HOUSTON, TEXAS

Crude oil pipe line from Yale, Okla., to Borger, Tex. This is 10¾" Electric Weld Line Pipe.

Here's line pipe that goes in fast in the field

Field welding joints before ditching Electric Fusion Weld Gas Line from Petersburg, Ohio, to Cleveland, Ohio. Three 60-foot joints were field welded together before coupling.

Take that Electric Resistance Weld Line shown above. Or a big 30" Electric Fusion Weld Line, shown at the right. When they're made by Republic, they have one thing in common:

They go in fast—And it's no accident. Circumference is always constant. That means field joints line up accurately and quickly. The entire circumference can be welded at top speed. Plus the fact that uniform wall thickness provides an even distribution of metal all around the pipe.

You can make smooth, uniform bends in the field. Why? High ductility. And because of uniform high yield strength, with Republic Line Pipe you can build high pressure lines. And uniform wall thickness means dependability in every inch of the line.

So when you need line pipe for oil and gas transmission, high or low pressure, remember, Republic makes both types—Electric Resistance Weld and Electric Fusion Weld. Also, Continuous Butt Weld Pipe for gathering lines. Write for more facts.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, New York

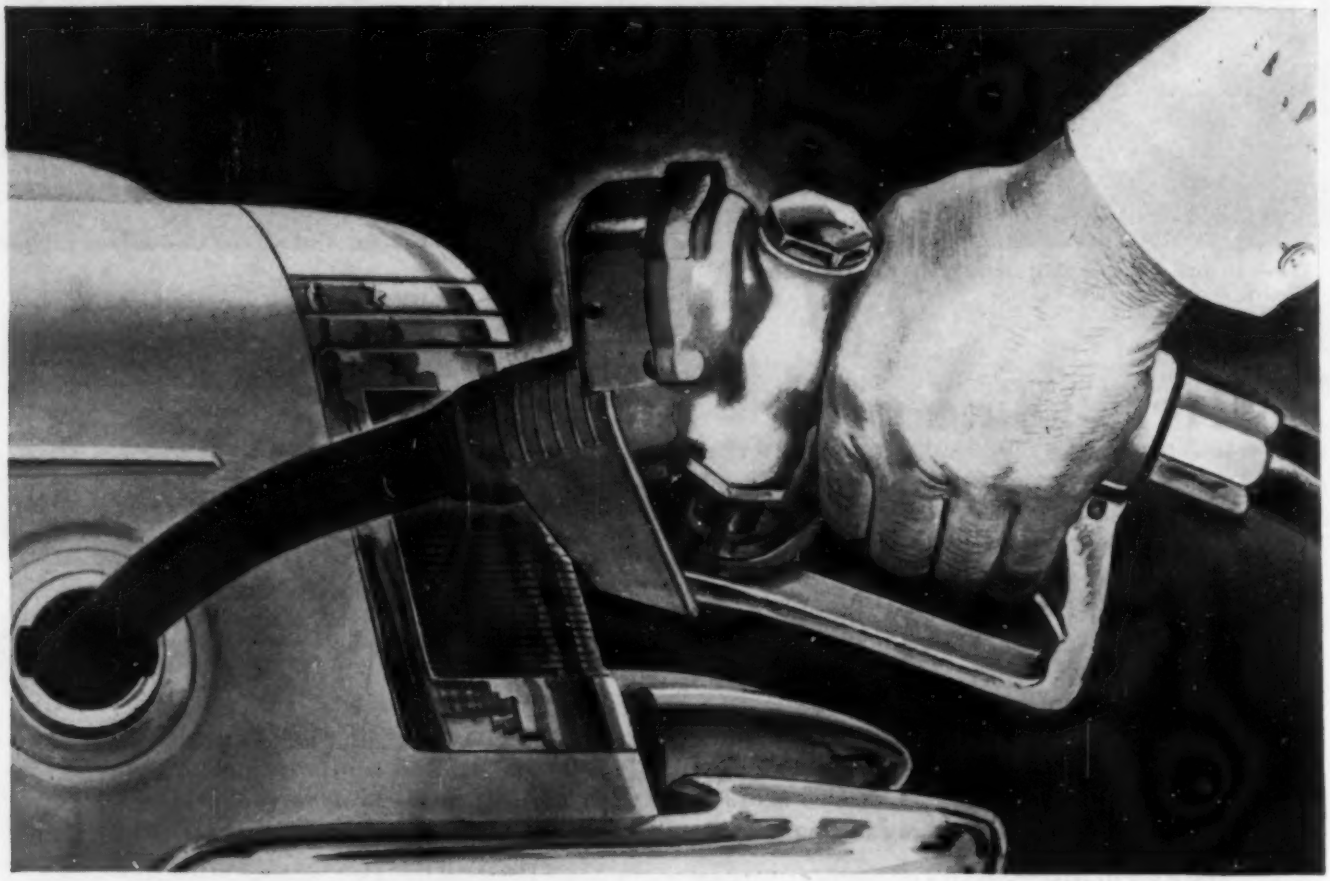
REPUBLIC STEEL

REPUBLIC LINE PIPE

ELECTRIC RESISTANCE WELD • ELECTRIC FUSION WELD
CONTINUOUS BUTT WELD

Other Republic Products include Casing and Tubing — Steel and Plastic Pipe — Studs, Bolts and Nuts — Heat Exchanger Tubes — Steel Buildings

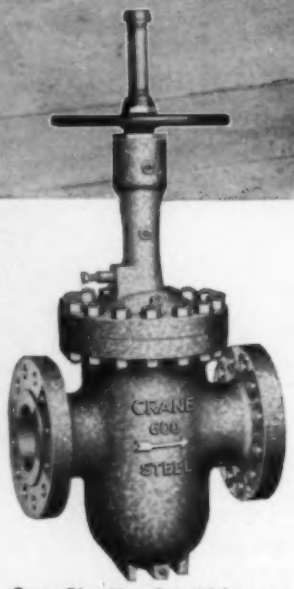
Here's one place where today's dollar goes further



In the fondly-remembered time of the nickel trolley and the 25¢ T-bone, gasoline for dad's 1925 model cost about 18¢ a gallon (excluding taxes). Sounds like a bargain—yet it really cost *more* than today's gasoline. The reason is clear when you keep this fact in mind: You fill your car's tank with gasoline, but what you're actually buying is *mileage*. Naturally, you'd rather pay $1 a gallon for gas that gave you 100 miles a gallon than buy 10¢ gas that delivered only 5 miles to the gallon. And that's why today's gasoline costs less than motor fuel of 1925 . . . it gives you *more miles to the dollar*. Research by companies such as Standard Oil Company of California has improved gasoline spectacularly over the years. This better motor fuel made more efficient auto engines possible, and together they give you up to 50% better mileage than motorists got in the '20's. On top of that, competition between oil companies has helped to hold down gasoline prices. Since 1925, they've risen only 20% (excluding taxes) while food has gone up 70%, clothing 63%, and the cost of living 53%. Compared to practically anything else you buy, gasoline is still a bargain. Any way you look at it, your money goes further when it goes for today's finer gasoline that gives you more miles to the dollar.

STANDARD OIL COMPANY OF CALIFORNIA

75 years of planning ahead to serve you better



Crane Pipe Line Gate Valves are made in Full-Way or Venturi patterns for working pressures up to 1440 pounds, oil or gas. Sizes 2 to 30 inch.

Dependable CRANE pipe line valves

CLASS 600 GATES

As new pipe lines are laid, more and more Crane Pipe Line Valves go in . . . to become a permanent part of the landscape.

The reason for the popularity of Crane Pipe Line Gates is their outstanding dependability. Even infrequent operation won't affect their efficiency. That's because all working parts are sealed in grease to assure smooth operation and positive closure of the dual-seating double disc. There's no problem of erosion either, since disc is fully seated in open position as well as closed position. Special plasti-packing forms a tight and durable stem seal.

And to assure smooth, clear flow with minimum pressure drop, Crane designed the conduit-type disc ports to coincide exactly with the seat openings. There are no pockets to catch dirt or cause turbulence. Read all about this pipe line favorite in your Crane 53 Catalog and in Circular AD-1864 available from your Crane representative, or write direct.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Announcing...

revolutionary new diesel fuel system... as simple as gasoline carburetion and ignition

Exclusive PT Fuel System now standard on all Cummins Diesels

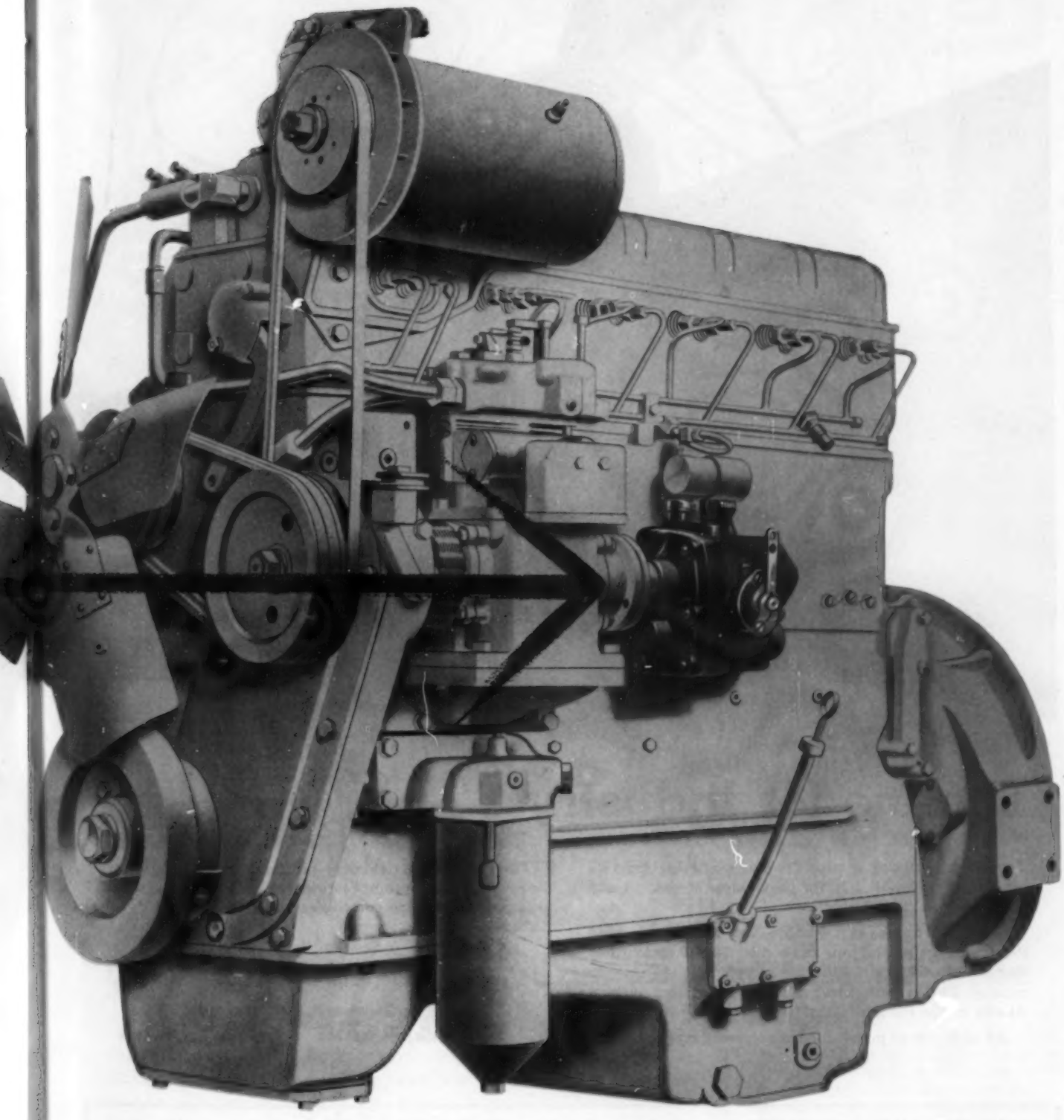
- Drastically reduces maintenance costs
- All mechanics can understand and service it
- Pump weighs only 13 pounds—system has no racks, check valves, metering plungers, discs, floats, etc.— does not have to be timed to engine
- Adaptable to all Cummins Diesels built since 1932

Write for your copy of descriptive folder "Cummins PT Fuel System."

CUMMINS **Cummins**

Engine Company, Inc., Columbus, Indiana

Leader in rugged, lightweight, high-speed diesels (60-600 h.p.)



Lifeline for industry

THE VAST NETWORK of pipe lines criss-crossing America are actually *lifelines* . . . for they transmit gas, oil and water essential to industry.

For the past four years we have been helping to extend these lifelines by shipping more than 24,000 carloads of Basalt-Kaiser Steel pipe to major projects throughout the country. This is enough to build a pipe line from Juneau, Alaska to The Panama Canal.

All of this steel pipe has been delivered *on time*.

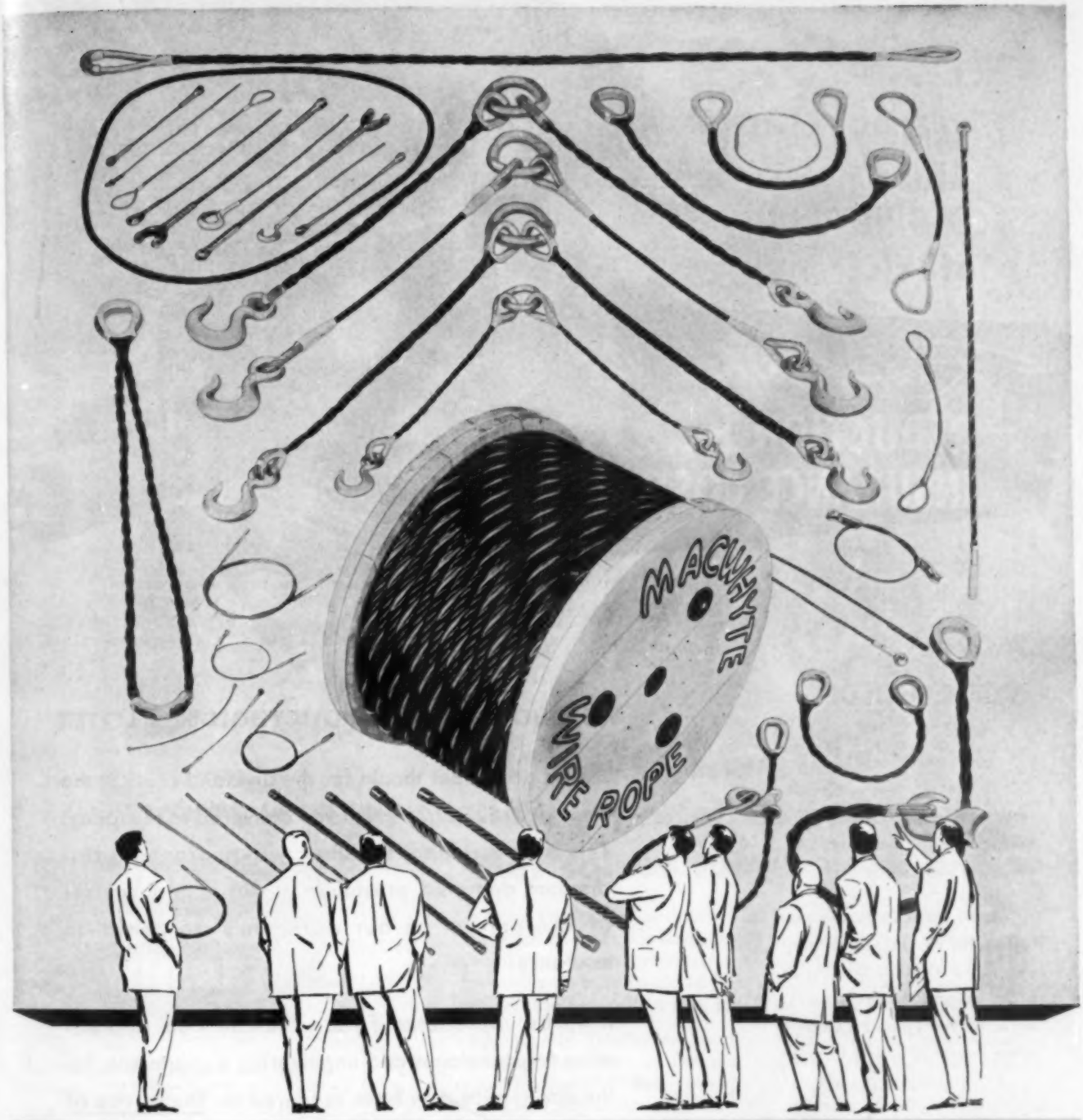
This dependable delivery—plus *uniform quality, wide range of sizes,* and *prompt service*—is another reason why experienced pipeline companies know they can rely on Kaiser Steel.

Kaiser Steel

KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Houston, Tulsa, New York



These ropes, slings, and assemblies provide a big selection for your needs

Shown above are Wire Rope products developed and manufactured by Macwhyte Company for maximum safety and economy. There are a thousand and one types and sizes of Wire Rope in Bright Steel, Galvanized Steel, Stainless Steel, and Monel Metal; hundreds of types and sizes of Braided Wire Rope Slings for materials handling; a wide selection of Wire Rope Assemblies for machine parts and controls; and Aircraft Control Cables, Assemblies, Terminals, and Tie-Rods for aircraft and other uses.

All these products are available from Macwhyte Company and distributors. Recommendations will be gladly furnished. A Macwhyte distributor will be pleased to serve you or write direct to:

Manufacturers of Internally Lubricated PREformed Wire Rope, Braided Wire Rope Slings, Aircraft Cables and Assemblies, Galvanized, Monel Metal, Stainless Steel Wire Rope, and Wire Rope Assemblies. G-16 Wire Rope Catalog available on request.

Mill depots: New York • Pittsburgh Chicago • St. Paul • Fort Worth Portland • Seattle • San Francisco Los Angeles

Distributors throughout the U.S.A.

MACWHYTE COMPANY, 2995 Fourteenth Avenue, Kenosha, Wisconsin

CLAIMS AND ENGINEERING SERVICE

Responsible for
REDUCTION in.... INSURANCE COSTS

What
POLICYHOLDERS *Say*

This is one of many testimonial letters received from policyholders of the Texas Employers Insurance Association.

Ask the Texas Employers representative nearest you to show you more of these letters, as proof of what Texas' largest writer of Workmen's Compensation Insurance can do for you.

40TH ANNIVERSARY 1914 1954

WE QUOTE FROM A POLICYHOLDER'S LETTER

"Please accept our thanks for the dividend check in the amount of $2,962.24 which you delivered to me today. This cash dividend, together with guaranteed cost discount deducted previously makes a total savings of 43.6 percent on our workmen's compensation insurance.

"It will be appreciated if you will express our appreciation to your claims and engineering departments for the fine service they have rendered us. The service of your safety engineer together with the promptness in which our claims have been handled are in a big way responsible for this nice reduction in our insurance cost."

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LETTERS

Sirs:

Volume 1, No. 1 of PIPE LINE INDUSTRY was received. I was very much pleased and impressed. In my personal opinion this publication will fill a tremendous need in our line of endeavor.

This looks like the beginning of a fine and valuable source of information. Congratulations on the first edition and keep up the good work.

W. F. NAEHER
Supervisor, Methods and Procedures
Transcontinental Gas Pipe Line Corp.
Houston

Sirs:

You are to be congratulated on setting up such a fine journal. From here on out you will lead the pipe line industry in this work.

FRANK H. DOTTERWEICH, Director
Division of Engineering
Texas College of Arts and Industries
Kingsville, Texas

Sirs:

I have just read the first issue of PIPE LINE INDUSTRY and I found the articles to be interesting and informative. Congratulations on your new venture.

E. CLYDE MCGRAW, Vice President
Transcontinental Gas Pipe Line Corp.
Houston

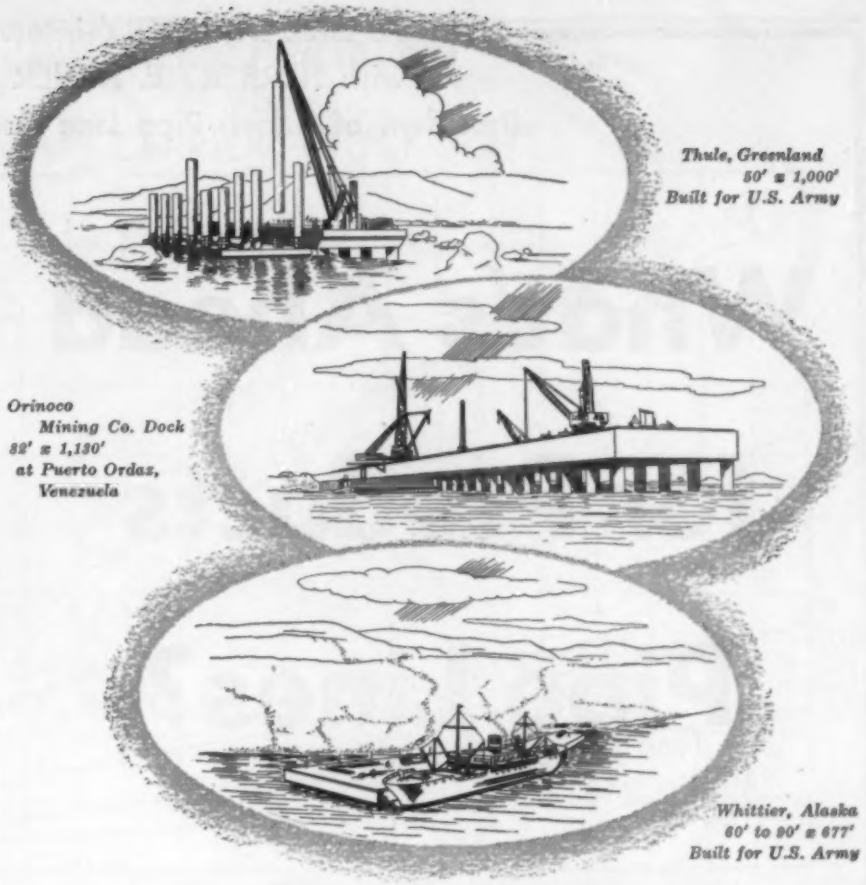
Sirs:

Congratulations on your new magazine . . . it appears to be of the same high quality as your other magazines.

WILL SWERDLOFF, Chief,
Economics, Development Sect.
Magnolia Petroleum Company
Dallas

WHO'S MEETING WHERE

AUG. 21	Southern Gas Association, Pipe Line Operations Conference, Herring Hotel, Amarillo, Texas
SEPT. 8-10	Mid-West Gas School and Conference, Iowa State College, Ames, Iowa
8-10	Pacific Coast Gas Association, Vancouver and Georgia Hotels, Vancouver, British Columbia
13-14	Independent Natural Gas Association of America, Roosevelt Hotel, New Orleans
15-16	American Gas Association, Sixth Annual Accident Prevention Conference, Bond Hotel, Hartford, Conn.
27-29	Electrical Conference of the Petroleum Industry, Petroleum Industry Committee of AIEE, Mayo Hotel, Tulsa
OCT. 2	Southern Gas Association, Right-of-Way Conference, Peabody Hotel, Memphis, Tenn.
9	Southern Gas Association, Natural Gas Roundtable, Rice Hotel, Houston
11-14	American Gas Association, Atlantic City, N. J.
NOV. 8-11	API, Division of Transportation, Chicago



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a PIPE LINE INDUSTRY interview
with HERBERT E. FISHER
President of Kaneb Pipe Line Company

What's Ahead for Products Pipe Lines?

HERBERT E. FISHER

- Products pipelining still in its infancy, vast growth seen.
- Widespread expansion predicted for main and lateral lines.
- Bulk plants, airports, service stations to be served directly.
- Railroads can no longer compete, except in isolated areas.

Q. *What's the general outlook for products pipe line construction in the next ten years?*

A. Products pipelining is still in its infancy. I believe we will see phenomenal growth during the next ten years.

Q. *What is the basis for this prediction?*

A. Simple economics. In most instances, the pipe line offers the cheapest and most efficient means of transportating products to market. It operates around-the-clock, does not have empty backhauls, and is not affected by adverse weather conditions. But more important still, the incremental cost for additional pipe line throughput is small. Once a line has been laid, its capacity can be increased—up to a point—for only 1 to 3 cents per barrel. This nominal amount is the cost of additional horsepower at existing pump stations and the federal transportation tax. Still greater throughput can be obtained by adding pump stations to the system. The cost of this additional capacity may run as high as 10 cents per barrel; but even this is small when compared to the normal 30 to 60-cent tariff.

No other means of transportation—barge, railroad, tanker or transport truck—can effect savings in this range by increasing haulage.

Q. *What pattern do you think future expansion of product lines will follow?*

A. First, the construction of large diameter, cross-country product lines is not over. During the next few years, we should see a number of new lines of this type, and because of the high construction costs that range from $40,000 to $100,000, most of them will be jointly owned.

Second, we will see more and more 2-inch to 6-inch laterals run from the large systems to distributing points in remote consuming areas. There is no reason why most bulk stations, and in some instances high-volume service sta-

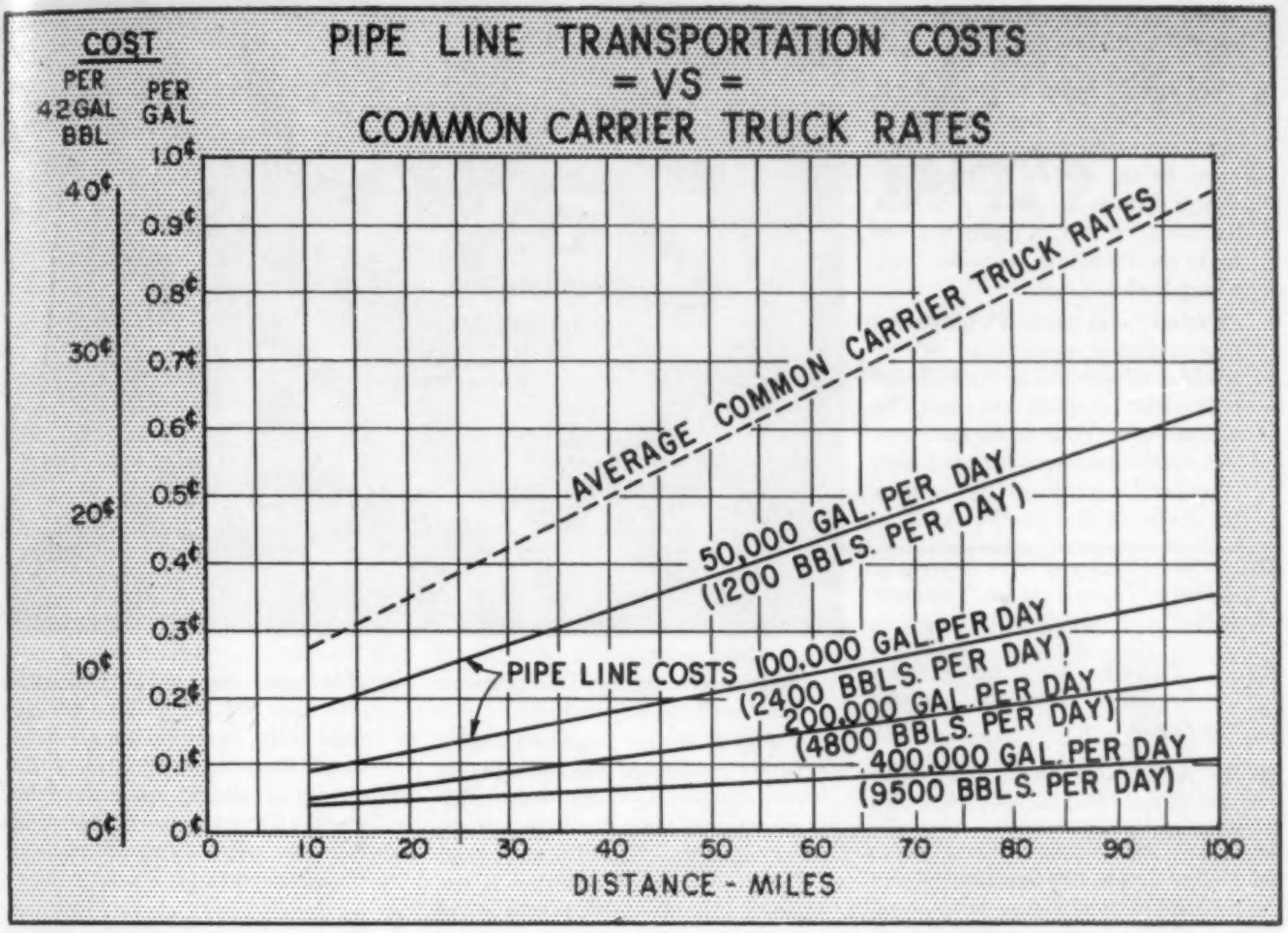


Fig. 1.—Despite high initial cost, pipe lines can haul petroleum products in sizable quantities much cheaper than trucks.

tions, should not be economically served directly by pipe line.

Q. *Are there any service stations today that are connected directly to a pipe line?*

A. I understand that in a few isolated cases, large-volume service stations are now being served by small-diameter laterals off of main-line systems.

Q. *What about bulk plants?*

A. A number of the major distributors, particularly on the East Coast, have connected bulk stations and terminals with 2-inch, 3-inch and 4-inch laterals. Most of these stations are small ones located in highly congested metropolitan areas.

Q. *Do you think more companies will follow this practice?*

A. Yes. We have natural gas distribution systems throughout our metropolitan areas serving industries as well as individual residences. It is reasonable to assume that the comparatively small number of bulk stations in a given area could be connected directly to a pipe line system. Aside from the transportation savings, one of the important advantages of this practice is that it further alleviates the serious truck congestions in such areas.

Q. *Wouldn't right-of-way procurement in corporate city limits make the cost of laying such lines almost prohibitive?*

A. Not necessarily. Virtually every metropolitan area is crossed by at least one railroad. In most instances, bulk stations are located on rail sidings and can be connected to pipe lines through use of the railroad right-of-way. It is quite likely that the railroads will cooperate closely with pipe line operators in solving the problem of distributing products within such areas.

Q. *Generally speaking, why haven't the numerous bulk plants near*

HERBERT E. FISHER, co-owner and managing director of the C. R. C. Engineering Company, pipe line design engineers, Houston. Also, president, Kaneb Pipe Line Company, a petroleum products pipe line system serving Kansas and Nebraska. Fisher has had 23 years of experience in the design, construction and operation of pipe line facilities. Previous to the formation of his own companies, he was associated with the Standard Oil Company of Indiana and its wholly owned subsidiary, Service Pipe Line Company. His engineering firm has been identified with a number of major crude oil, products and gas pipe line projects in the U. S., Canada and several foreign countries. Fisher is a registered professional engineer and is particularly well known throughout the oil industry for his active participation in pipe line technology related to products systems.

existing cross-country lines been served in this way?

A. This wasn't feasible until recent years. Before the development of automatic control equipment and prior to the advancement of industry know-how on product batching, it was not practical to make small-volume deliveries from a large-volume system.

Newly developed equipment now makes it possible to deliver tenders to small and unattended bulk plants at minimum cost. The utilization of both radio and wire line communications for operation of control equipment has been a big factor in this development.

Q. *Are there many of these automatic delivery installations planned today?*

A. Yes. There are a number of them in the design stage that appear practicable.

Q. *Do you think airports near products systems will be served directly from the line?*

A. Definitely yes. We are now in the process of connecting several of the major air bases in the U. S. to pipe lines. The savings to civilian and Air Force users certainly will merit the installation of many such lines. There are no insurmountable problems in handling all grades of jet fuel and Av-gas through a products pipe line system which also handles conventional brands of fuel.

Q. *How does the cost of handling products by railroad and truck compare with pipe line shipping?*

A. The railroads can no longer compete with pipe lines except in isolated areas where consumption is low. Even these normally are served by truck.

Today, most of the short haul business is done by transport trucks. But trucking costs are on the increase. Highway congestion is becoming a more serious problem every year. Eventually some of this business may be taken over by pipe lines.

For distances from 10 to 100 miles, pipe lines offer enormous savings over trucks. This is shown graphically in Figure 1.

TABLE 1
50-Mile Pipe Line Haul

Volume, Gal. per Day	50,000	100,000	200,000	400,000
Truck Rate, per Gal.	0.61¢	0.61¢	0.61¢	0.61¢
Pipe Line Cost, per Gal.	0.37	0.21	0.14	0.07
Savings, per Gal.	0.24¢	0.40¢	0.47¢	0.54¢
Daily Savings	$ 120	$ 400	$ 940	$ 2,160
Annual Savings	$ 43,800	$146,000	$343,100	$788,400

TABLE 2
75-Mile Pipe Line Haul

Volume, Gal. per Day	50,000	100,000	200,000	400,000
Truck Rate, per Gal.	0.82¢	0.82¢	0.82¢	0.82¢
Pipe Line Cost, per Gal.	0.50	0.28	0.17	0.09
Savings, per Gal.	0.32¢	0.54¢	0.65¢	0.73¢
Daily Savings	$ 160	$ 540	$ 1,300	$ 2,920
Annual Savings	$ 58,400	$197,100	$474,500	$1,065,800

For a better comparison of trucks versus pipe lines, as a means of transporting petroleum products, let us assume two hypothetical examples (see Tables 1 and 2): If the pipe line distances between origins and destination points are 50 to 75 miles respectively, and the highway mileage is approximately 10 percent longer, we find that the net savings per gallon varies from 0.24 cents to 0.73 cents. For the shipper, this means an annual added profit of from $44,000 to more than $1 million, depending on the volume handled, and the distance transported.

Q. *Do these figures reflect costs in any specific locality?*

A. The data shown on the charts are not represented as being applicable in specific cases but are reasonably accurate and representative of average costs today. Obviously there are many points in a marketer's trade territory in which the daily requirements are considerably lower than the 50,000, 100,000 and 200,000 gallons per day used in the examples. On the other hand, there are some areas where one or a group of marketers could advantageously use small diameter pipe lines in place of transport trucks.

Q. *Who do you think will build such lines?*

A. Such pipe lines can be built by outside independent capital or as shipper-owned facilities. In either event, low-cost pipe line transportation can be made available. Refineries may also find that these small diameter lines can further extend the area over which their products can be marketed at a freight advantage.

Q. *Do you think pipe lines may eventually drive large common carrier truck operators out of business?*

A. No. Transport trucks will continue to play an important part in the distribution of petroleum products, even though the use of smaller diameter pipe line systems may replace the long truck hauls and some of the shorter hauls in congested areas.

It is not too unreasonable to assume that the larger operators may enter the pipe line industry and avail themselves of the transportation savings of small diameter laterals. —**The End**

HOW DO YOU LIKE IT?

- **This is YOUR magazine . . . Written and edited to help you with your job . . . Your suggestions are invited!**

What Employers Would Most Like to See in an Employe

We asked nearly 300 executives to name the qualities they would most like to see in those who work for them. Read this and see if you measure up to standards.

By AL REESE, PIPE LINE INDUSTRY Staff

THE MEN whose ambition built the pipe line industry have named the trait they most like to see in their employes.

It is Ambition.

PIPE LINE INDUSTRY asked nearly 300 contractors, heads of pipe line companies, and top executives in pipe line departments: "What are the six qualities you like best to see in an employe?"

Ambition was the only trait named by everyone who replied. The other qualifications, listed according to the number of times mentioned, were:

- Cooperation.
- Personality.
- Character.
- Job efficiency.
- Resourcefulness.

Not everyone used exactly the same words to describe the qualities they consider most desirable, but the phrasing allowed the arrangement of the traits most valued into logical categories. In the case of ambition, the executives used these definitions:

Enthusiam for work.

Interest in, and enjoyment of, their work.

Industriousness.

Aggressiveness.

A greater desire for self-development than for security.

Doing a little more than the employer expects.

The desire to advance by merit.

The desire to learn the business.

The desire to learn the job just ahead.

Home study.

But with all their emphasis on ambition, the executives want none of the furious fellow who regards the vertebrae of his immediate superior as a foot-bridge to success.

One employer defined ambition as "a strong desire to acquire recognition and to progress without sacrificing performance standards or at the expense of others."

Rare trait. Another believes that bustle and ambition aren't necessarily synonymous. The quality he had in mind ". . . includes the willingness to devote the time, suffer the inconvenience, and exert the physical effort necessary to accomplish the job or a little more." But—"Above all, it requires the absence of mental lethargy. I am inclined to believe the absence of mental lethargy is the quality least frequently encountered in employes."

The evidences of ambition most appreciated by still another executive illustrate how closely allied are the qualities desired in an employe. In a definition that could be equally well applied to Cooperation, the second most popular trait listed, he termed a truly ambitious man as one ". . . who knows that advancement must be earned and who looks to his associates and those under his supervision to promote him, or at least be pleased should he be promoted."

In the category of Cooperation there was little variance as to phraseology. Most expressed it simply as "The ability to work with people" through expression of patience, tolerance, kindness, fairness, and the respect for the aims, opinions and rights of others. By "others," the majority were referring to fellow employes, but some went further. One executive wants men with ". . . the ability to deal effectively and harmoniously with people at all levels in the company, and with people outside the company with whom the employe comes into contact in the course of his duties or related activities."

Personality portrait. Going still further, another acclaimed ". . . the ability to work with others in an open-minded, friendly and harmonious manner." He thereby edged into the orbit of Personality, the third most desired qualification. The composite portrait of a man with a good Personality, as painted by the executives in one-word strokes, is of one who is pleasant without constant display of denture, self-reliant without brassiness, courteous without servility, and modest without self-effacement. He is neat, alert, prompt. He is neither belly-acher nor bootlicker. He is also healthy, and since this frequently presupposes moderate habits, the thread which weaves together the desired traits again becomes apparent, leading now into Character.

Bulwark of this category is Honesty, the word occurring in the replies more frequently than any other save one—Loyalty. Next to honesty, the executives put most emphasis on sane habits, after which came church affiliation and civic responsibility.

Job efficiency. The fifth characteristic on the list might have occupied a

Continued on Page 43

Engineers as Followers and Leaders

There are three leadership approaches—autocratic, democratic and free rein. To learn in what group you fit best, as follower and leader, read this article, then take the test.

By AUREN URIS, Research Institute of America, New York

WHAT KIND OF people are engineers, anyway?

You've seen engineers' income, hours worked, turnover rate, absenteeism, surveyed, averaged and charted. Any group, of course, may be studied on the basis of a shared activity. But how about engineers as people, as psychological beings?

Consider statements like these, for example:

"Engineers are easy to deal with."

"Engineers are tough to deal with."

You've surely heard engineers cheered or verbally sent to the showers in some such summary fashion. Is there really any justification for such group evaluation? Do engineers, psychologically speaking, represent a type of *homo sapiens* separate and apart from their fellow humans?

Engineers under the Microscope—A recent study provides an interesting and revealing insight into the psychology of engineers as a group. The leadership and followership tendencies of an ASME group meeting on Long Island were tested. Included were men involved in research and development, design, standards, liaison, and production.

Before getting into the study results, here's some background information that will put the study in perspective.

A New Approach to Leadership—Within the last few years a somewhat new concept of leadership and followership has been developed. It's a flexible approach, and attempts to right the balance brought about by an overemphasis on democratic techniques.

There's no question but that democratic leadership has much to recommend it. The trouble is that in concentrating on the virtues of this one method, many people lost sight both of the handicaps of the democratic techniques and also of the virtues inherent in other possible approaches.

A re-examination of the leadership facts of life as they actually exist rather than as the theorists would like to see them, reveals this state of affairs: There are three leadership approaches or tools that may be used in leading a group of engineers—or any other type of group. Each of these three methods, under given conditions, has certain advantages. Each of the three methods likewise has certain disadvantages.

Here are the three leadership tools, and a brief description of each.

Autocratic leadership. Using this method, the leader assumes full responsibility for all group action. Obedience is his main request of subordinates. Policy and decision-making are his babies.

This approach is best when group members are inexperienced, dependent, or insecure. Or, when a critical situation requires immediate aggressive, single-minded action.

Democratic leadership. The leader draws ideas and suggestions from his group by discussion and consultation. Group members are encouraged to join in setting policy and in developing the regulations by which the group as a whole is to live and work.

This type of leadership is particularly effective where a work-group is cooperative and capable of carrying out group responsibilities. Or, when the benefits of group thinking are desirable.

Free rein. The leader exerts minimum control. He's on hand mainly to provide materials, information and so on.

This leadership method is particularly suited to individuals whose training and experience equip them to function pretty much on their own. Or, with groups—such as engineers—

where individual imagination and initiative, given free play, best stimulate group progress.

Your Followership—The "flexible" leadership concepts were used to develop two tests, one for leadership tendencies of individuals, the other for "followership" tendencies.

(These tests are reproduced at the end of this article. You may take them yourself, and evaluate your score, using the scoring instructions provided.)

An individual's "followership" is defined as the type of leadership under which he prefers to work. It is also likely to be the type of leadership under which he will find most emotional satisfaction in his work, and under which he will be most productive.

Followership can be related to the three leadership approaches previously described, in this fashion:

1. **Autocratic** leadership is what you prefer if you—
   - . . . are most efficient working under complete and detailed instruction.
   - . . . show a marked respect for firmness in your leadership.
   - . . . accept authority unquestioningly.

2. **Democratic** leadership tends to be preferred by those who—
   - . . . like to consult with you on departmental problems rather than take the position of "That's your headache!"
   - . . . are active participants in productive group meetings.
   - . . . apply the principles of mutual respect among themselves.

3. **Free-rein** leadership attracts those who—
   - . . . place a high value on initiative and want to be self-reliant.
   - . . . seem to work best when given a completely free hand.
   - . . . are capable of assuming full responsibility for their actions.

Implications for Engineers—The ASME group scores made in both the leadership and followership tests were compared to those of a so-called "normal" group. Here are the figures in the leadership area: The percentages indicate that "strength" of the tendency towards the type of leadership indicated:

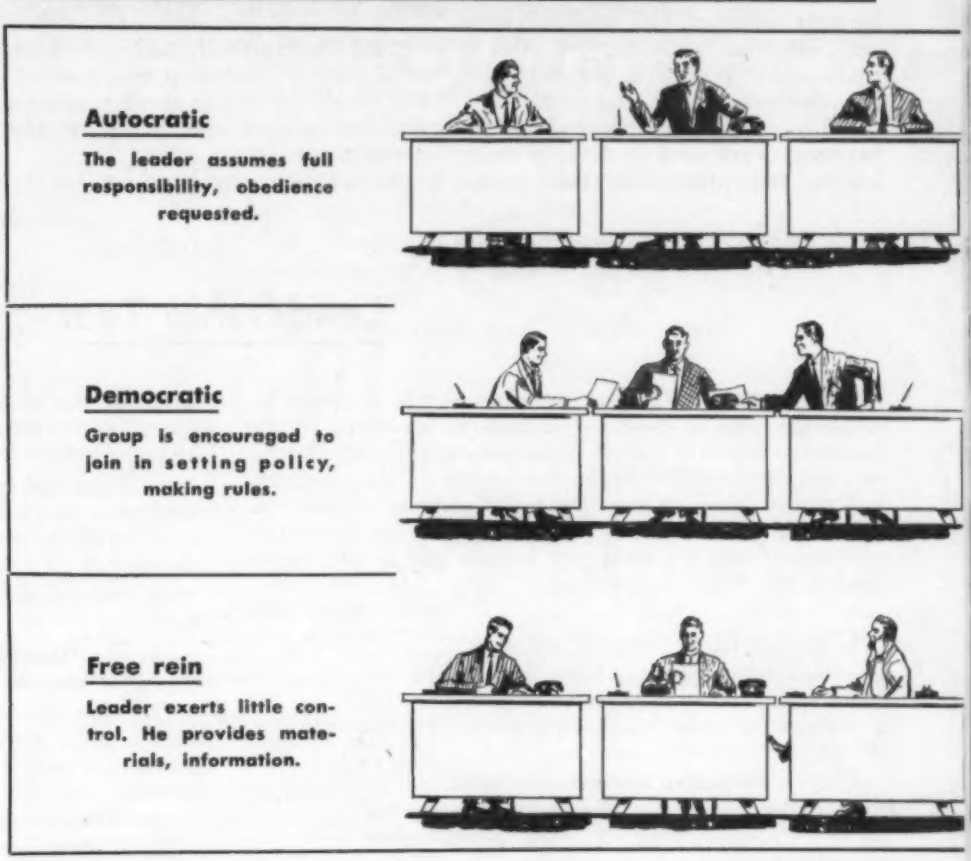
Leadership Ratings

Autocratic responses:
- Engineers . . . . . 23 percent
- Normal . . . . . 25 percent

Democratic responses:
- Engineers . . . . . 48 percent
- Normal . . . . . 44 percent

Free Rein responses:
- Engineers . . . . . 33 percent
- Normal . . . . . 31 percent

Three Approaches to Leadership of Engineers . . .


Autocratic
The leader assumes full responsibility, obedience requested.
Democratic
Group is encouraged to join in setting policy, making rules.
Free rein
Leader exerts little control. He provides materials, information.

Interpreting the Results—The percentages above indicate relatively little difference between the engineering group and the "normal" group. The differences in scores are too small to be significant.

What this means is that, as far as the leadership tendencies of the engineering group tested, they were in no special way distinguishable from an average business group. There is the some marked preference for the democratic method, with the autocratic and free rein responses approximately equal.

It should be pointed out, however, that while the "normal" group shows only a 6 percent difference between its autocratic and free rein responses, the engineering group shows a difference of 10 percent. As you will see, this percentage—the difference in attitude towards autocratic and free rein methods—jumps decidedly in the followership test scores shown in Figure 1.

Explanation?—How can the group engineering score be explained? There are two pretty clear implications, probably not unrelated:

- The kind of people who chose engineering as a profession like to work on their own, with a minimum of guidance. They want to be left on their own initiative, within the framework, of course, of the goals set them

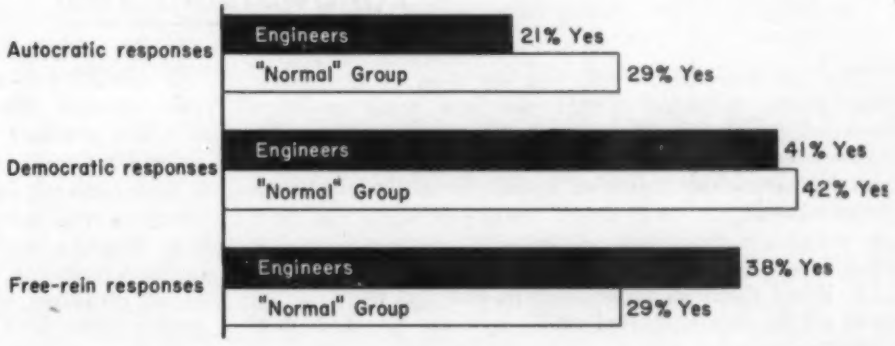


Figure 1
(Courtesy Research Institute of America)

by their superiors. This same character trait, incidentally, probably applies to professional people in general, doctors, lawyers, writers, and so on.

• The conditions under which supervisors work tend to develop those habits, and preferences that go to make for self-reliance, and the exercise of personal initiative.

Test Yourself—By taking the leadership and followership tests that follow, you'll be able to check your own findings against the group results given above.

No claims are made, as yet, for the scientific validity of these tests. But on the whole, individuals tested have agreed that their scores have a relation to their actual work experience. Even more to the point: those who have taken the tests have suggested personal gain in the increased insight into their own superior-subordinate job relationships.

Leadership Test

The questions below can reveal to you in approximate terms the type of leader you tend to be. Some of the questions you will be able to answer offhand. A few may require careful thought. But answer all the questions, and answer them as honestly and accurately as possible. Where the question asked has no ready answer from your experience, indicate what you believe you would do or think in the situation described.

	YES	NO
1. Do you enjoy "running the show"?	( )	( )
2. Generally, do you think it's worth the effort to explain to subordinates the reasons for a decision or policy before putting it into effect?	( )	( )
3. Do you prefer the administrative end of your leadership job—planning, paperwork, and so on—to supervising or working with your subordinates?	( )	( )
4. A stranger comes into your department and you know he's the new employe hired by one of your assistants. On approaching him, would you first ask his name rather than introduce yourself?	( )	( )
5. Do you keep your people up-to-date on developments affecting them?	( )	( )
6. Do you find that in giving out assignments, you tend to state the goals, leave methods to your subordinates?	( )	( )
7. Do you think that it's good common sense for a leader to keep aloof from his people, because in the long run familiarity breeds lessened respect?	( )	( )
8. Comes time to decide about a group outing. The majority prefer to have it on Wednesday, but you're pretty sure Thursday is better for all concerned. Would you put the question to a vote rather than make the decision yourself?	( )	( )
9. If you had your way, would you make running your group a push-button affair, with personal contacts and communications held to a minimum?	( )	( )
10. Do you find it fairly easy to fire someone?	( )	( )
11. The friendlier you are with your people, the better you can lead them. Correct?	( )	( )
12. After considerable time, you dope out the answer to a work problem. Your assistant promptly pokes it full of holes. Would you be annoyed that the problem is still unsolved, rather than become angry with the assistant?	( )	( )
13. Do you agree that one of the best ways to avoid problems of discipline is to provide adequate punishments for violations of rules?	( )	( )
14. Your way of handling a situation is being criticized. Would you try to sell your viewpoint rather than state that, as boss, your word is final?	( )	( )
15. Do you generally leave it up to your subordinates to contact you, as far as informal day-to-day communications are concerned?	( )	( )
16. Do you expect subordinates to feel personally loyal to you?	( )	( )
17. Do you favor the practice of appointing a committee to settle a problem rather than stepping in to decide on it yourself?	( )	( )
18. Some experts say differences of opinion within a group are healthy? Agree?	( )	( )

Followership Test

The questions below tell you the type of leadership you prefer. Whether or not you now work under a superior, you undoubtedly have done so in the past. Answer the following questions, keeping in mind what you have done or feel you would do in the situations described.

	YES	NO
1. When given an assignment, do you like to have all the details spelled out?	( )	( )
2. Do you think that, by and large, bosses are bossier than they need be?	( )	( )
3. Would you say that initiative is one of your stronger points?	( )	( )
4. Do you feel a boss lowers himself by palling around with his subordinates?	( )	( )
5. In general, would you prefer working with others to working alone?	( )	( )
6. Would you say you prefer the pleasures of solitude (reading, listening to music) to the social pleasures of being with others (parties, get-togethers, etc.)?	( )	( )
7. Do you tend to become strongly attached to the bosses you work under?	( )	( )

8. Do you tend to offer a helping hand to the newcomers among your colleagues and fellow workers? ( ) ( )

9. Do you enjoy using your own ideas and ingenuity to solve a work problem? ( ) ( )

10. Do you prefer the kind of boss who knows all the answers, to one who, not infrequently, comes to you for help? ( ) ( )

11. Do you feel it's OK for your boss to be friendlier with some members of the group than with others? ( ) ( )

12. Do you like to assume full responsibility for assignments, rather than just do the work and leave the responsibility to your boss? ( ) ( )

13. Do you feel that "mixed" groups—men working with women, for example—naturally tend to have more friction than unmixed ones? ( ) ( )

14. If you learned your boss was having an affair with his secretary, would your respect for him remain undiminished? ( ) ( )

15. Have you often felt that "he travels fastest who travels alone"? ( ) ( )

16. Would you agree: a boss who can't win your loyalty shouldn't be boss? ( ) ( )

17. Would you get upset by a fellow worker whose inability or ineptitude obstructs the work of your group? ( ) ( )

18. Do you think "boss" is a dirty word? ( ) ( )

Scoring

To get your score, follow this procedure for each test:

a. Ring all the question-numbers below which you answered "Yes".

Leadership

I. 1, 4, 7, 10, 13, 16
II. 2, 5, 8, 11, 14, 17
III. 3, 6, 9, 12, 15, 18

Followership

I. 1, 4, 7, 10, 13, 16
II. 2, 5, 8, 11, 14, 17
III. 3, 6, 9, 12, 15, 18

b. Count the "Yes" answers you've indicated for rows, I, II and III.

c. Fill in the three totals in the columns below.

Leadership

I.___autocratic tendency
II.___democratic tendency
III.___free rein tendency

Followership

I.___autocratic tendency
II.___democratic tendency
III.___free rein tendency

Evaluation

The following analysis applies to both your leadership and followership scores. In general, there are four possible types of scores:

High scores. Any category in which you scored from 4 to 6 "yes" answers is one toward which your inclinations are strong. Let's say, for instance, that your leadership score read like this: autocratic—5; democratic—3; free rein—1.

Your autocratic leadership tendencies would tend to be quite pronounced. That is, you would have a decided preference for an autocratic superior.

Low scores. Another possibility is that your score didn't go about three "yesses" in any of the categories. Here's a followship score of this kind: autocratic—2; democratic—2; free rein—1.

Behind low scoring you're likely to find an individual without strong feelings about working under any of the three types of leadership. He would do almost as well under a boss using any one of the three methods.

Balanced scores. A particularly interesting type of score is one of this kind: autocratic—3, democratic—3, free rein—3.

Evenly distributed scores generally reveal a personality sympathetic to all three methods. People who make this kind of score have a well-proportioned personality. It's a desirable balance. Under ordinary circumstances they will have less of a problem in adjusting to the realities of the superior-subordinate relationship.

Such a score, however, is not usual. The reason is that preference for the autocratic and free rein methods often require emotional outlooks which are directly opposed to one another. Such conflicting elements seldom are found within the personality of a single individual.

In most cases, balance is less perfect.

Let's say your scores were slightly off balance—3, 2, 1, for example. Your autocratic preference is there all right, but it's not too pronounced. Chances are, people with scores of this kind would find little more difficulty in functioning under a free rein leader than an autocratic one.

Unbalanced scores. A score that is high in one category, low in the other two, has clear-cut implications. Take this possibility, for example: autocratic—0; democratic—6; free rein—1.

It's a safe bet that a person getting this kind of score has a strong preference for democratic leadership. In addition, he has tendencies **away** from the other two types.

Employers

Continued from Page 39

much higher position but for the fact that some of the executives considered it so fundamental a requisite as to be taken for granted. As one put it: "We have purposely not touched on technical qualifications, since satisfactory ability to perform technical skills would seem to be the very minimum required before an employe could even be considered for a job."

A great number, however, thought it important to point out their interest in certain aspects of job efficiency, aside from job knowledge. These included cost-mindedness, interest in the quality of products over and above the individual worker's direct responsibility therefor, the ability to see through details, an analytical mind, and the ability to apply job knowledge through reason.

Sixth trait. In voting Resourcefulness into the six select traits, the management men stressed the value they place on employes who can push to completion a task that does not exactly follow a familiar pattern, thus demanding Initiative—a word used only less frequently than Honesty and Loyalty in the replies received. Others said they want men who:

Are open to new ideas.
Have creative minds.
Are adaptable.
Can handle varied assignments.
Can plan their own work.

Three other oft-mentioned traits were implied to a large extent in the top six qualifications. They are Loyalty, Dependability and Leadership, desired by the executives in the order listed. These three, combined with all the others, add up to an employe described by a company president as "A loyal, worthy and honorable man whom I will respect and who will respect me." —**The End**

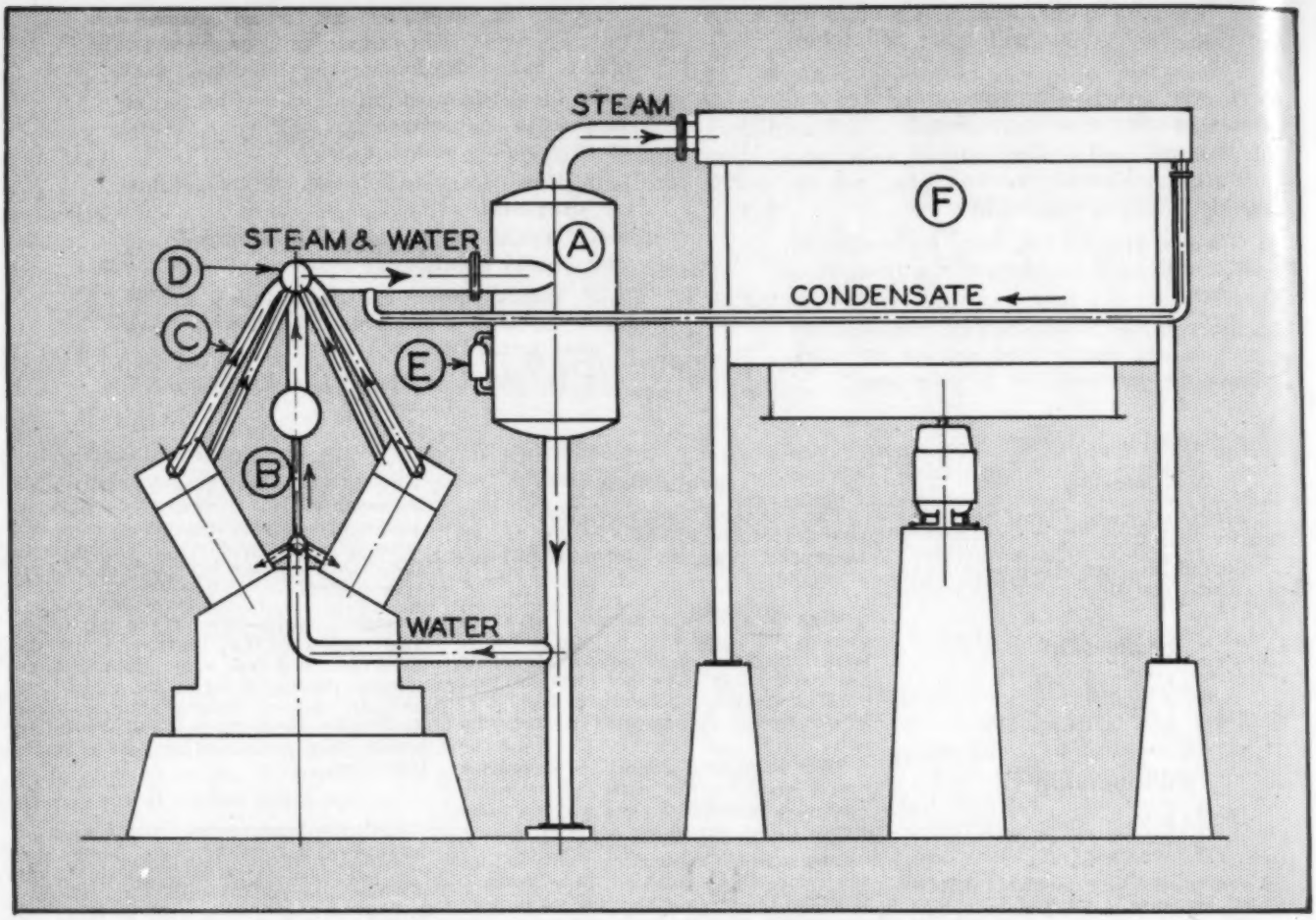


Figure 1. Vapor phase unit with thermal circulation cycle.

Have you considered . . .

Vapor Phase Engine Cooling

- Inherent temperature control
- No circulating water pumps
- Reduced engine wear
- Cheap steam supply

LLOYD C. HARBERT, Engineering Controls, Inc., Los Angeles

ENGINE JACKET cooling is experiencing a revolution in California. The method, termed "vapor phase cooling," utilizes water at its boiling point, thus taking advantage of the large latent heat of vaporization in preference to sensible heat realization in conventional systems. The steam so produced can be put to convenient use.

Actually the method has been in use since 1939 but it has not been until the last few years that great strides have been made to increase its scope to the 250,000 bhp of gas and diesel engines now so equipped.

The revolution does not end here. Another development, termed "thermal circulation," eliminates the circulating water pump in the system. No new method either, this alternative merely permits natural circulation of the coolant and has been variously known as thermo-siphon, cooling by ebullition, and boiling point cooling.

Thermal Circulation Cycle—Figure 1 shows the system connected to the power cylinders of a large gas engine driven compressor. Two circuits are employed. The primary circuit, being the coolant, flows out of the vapor phase unit "A" through the engine jackets and back, repeating the cycle. Upon first starting the engine and until it has run for several minutes, there will be no movement of the coolant. When sufficient heat has been

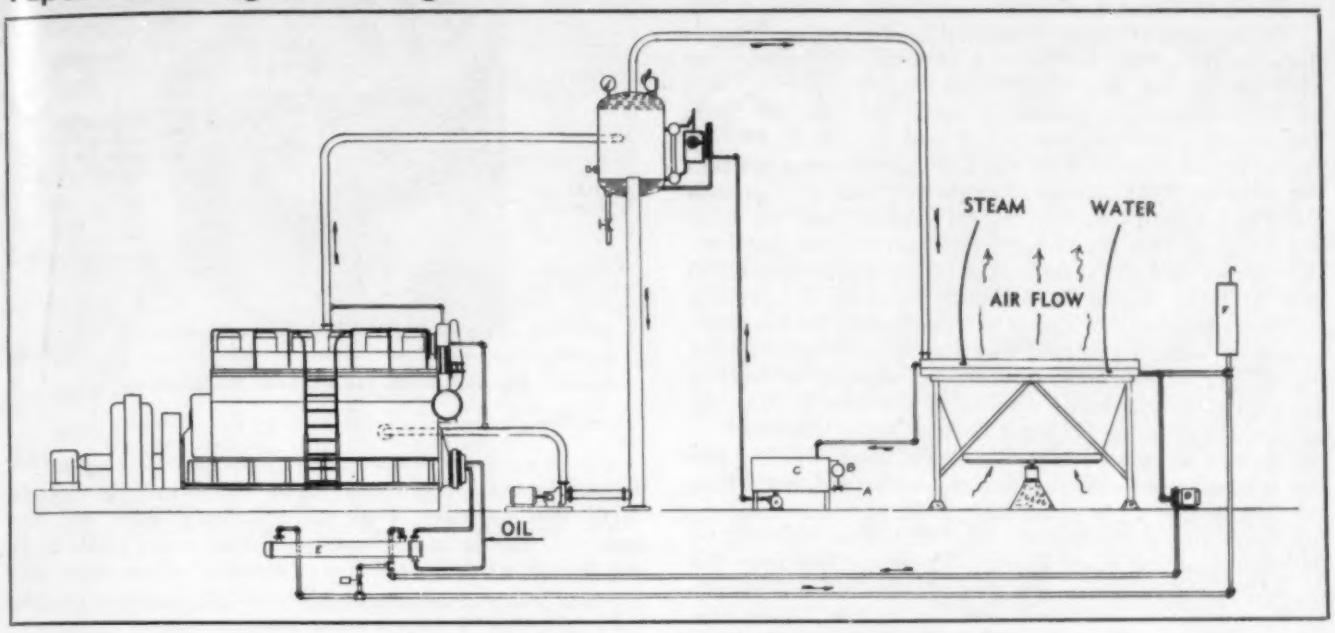


Figure 2. Vapor phase unit with engine driven water pump.

rejected, ebullition will commence in the cylinder head and the upper part of the cylinder jacket, starting circulation. As load is applied, circulation will increase, in direct proportion to the load. Under full load, some ebullition will occur, as low in the cylinder as the end of the piston stroke and will increase in intensity as the water, carried along with the steam, passes upward around the combustion chamber and the water cooled exhaust manifold, much the same as it does in a water tube boiler or a pan of boiling water when the flame is turned up.

The water and steam enters the vapor phase unit tangentally, causing it to swirl around inside. Any scale or foreign matter in the coolant is thus thrown down in the mud drum built in at the bottom of the unit, where baffles arrest the swirl and trap the solids, which are then drawn off by blow down.

The steam separator, built in at the top of Unit A, dries the steam, which passes through the secondary circuit, being a steam condensing coil in Unit F. This unit also contains a water coil for lube oil cooling. The steam condensate returns to the primary circuit at the point shown. The condensate may at times, be sub-cooled, therefore it is desirable to have it enter as near "D" as possible so it will be heated to boiling before it enters Unit A.

Piping for Thermal Circulation—As considerable steam will form in the engine jackets, somewhat larger outlet lines are required. It is imperative that the system be so piped as to insure the inlet leg, solid water, being heavier than the outlet leg of water and steam, to insure a minimum of restriction. The inlet water header is tapped and a small line installed to carry water to the exhaust manifold "B". Usually, though not always, an auxiliary line "C" is required to pass all water and steam out of the cylinder and head. An additional pipe manifold "D" is installed above manifold "B," where the auxiliary line "C" and the one supplied with the engine are tied in. By separating the flow through the exhaust manifold "B" from the jackets, a free flow through all parts is obtained.

Unit A is mounted low, the bottom of the unit being even with the top of the water jacket. The low water switch "E" being positioned so that when the water level in the unit falls to unsafe level, the engine will shut down while the jackets are still full of fluid.

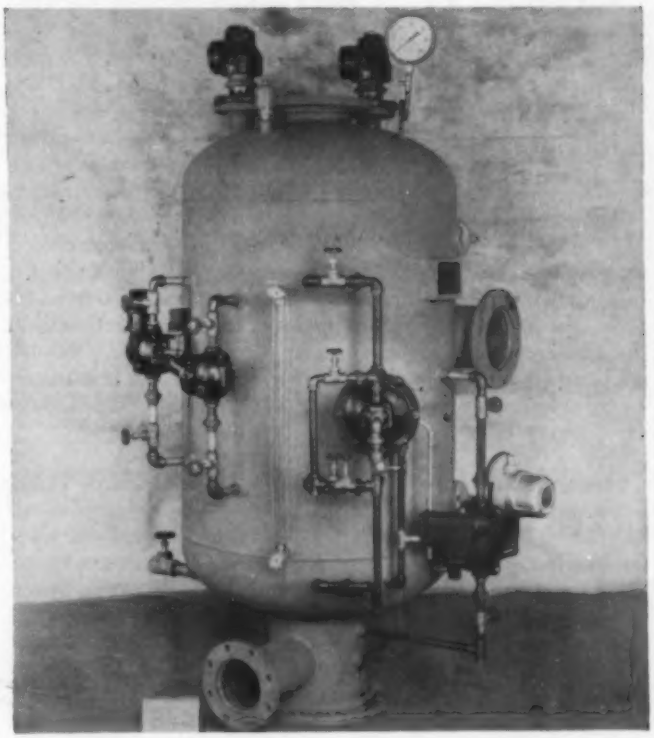


Figure 3. Special controls for vapor phase units.

Where the steam condenser can be mounted at the height shown and when the condensate header of the steam condenser is at least 24 inches above normal liquid level in Unit A, the condensate will flow back to the primary circuit by gravity. Unit A is normally supplied with a pressure relief valve, pressure gauge, air vent valve, gauge glass and an automatic fresh water make up valve, in addition to the low water float switch.

Circulating Rates—The rate of water circulated in a vapor phase-thermal circulation system is essentially the

same as that of a water tube boiler and is approximately as shown in Table A.

The amount of steam generated in the engine depends upon its type, size and load. A naturally aspirated, four cycle gas engine, requiring 10,000 btu input per bhp will produce about three pounds of steam per bhp/per hour. The rate of water required, at full load, to cool a 1000-bhp engine of this type, will be about 3 pounds steam per bhp per hour or, 3000 pounds of steam per hour x 18 pounds water to 1 pound steam = 54,000 pounds water per hour or, 108 gpm. This represents 0.108 gpm of water per bhp. In order to cool the same engine in the liquid phase, 600 gpm of water would be required, in order to obtain a 10-degree temperature rise across the engine, because each pound of water circulated will absorb only one btu per pound, per degree temperature rise, whereas in thermal circulation only a small percent of the heat is removed as sensible heat, the greatest portion being absorbed by the coolant as latent heat. This means much smaller, and less expensive lines. While the outlet water and steam line, running to the vapor phase unit, is larger than required for conventional cooling the inlet line from the unit, to the engine, can be much smaller. The steam line from the vapor phase unit to the steam condenser for a 1000-bhp gas engine will require an 8 inch line and the steam condensate, being only 6 gpm, will require a 1½ inch line.

Lube Oil and Lube Oil Cooling—Where dry type pistons are used, lube oil cooling is not required with vapor phase. Where oil cooled pistons are used the lube oil must absorb about four to five times as much heat; therefore, it must be cooled.

High grade lube oils, of the straight mineral type, are adequate for all gas engines cooled by vapor phase. Engine metal temperature, surrounding the combustion chamber, in many engines tested, are no higher than in engines conventionally cooled. Since any engine cooled at temperatures above the dew point, (194 degrees F., minimum metal temperature) no condensing of the water from the products of combustion can be formed within the cylinders; thus acid formation is eliminated, because acid can form only in the presence of moisture, regardless of the amount of H_2S contained in the engine fuel. Therefore, heavy duty lube oils are not usually required.

Heating of Idle Engines—Where individual vapor phase units are desired, for several engines in one station, so that each engine cooling system may be moved with the engine to another location, it will be necessary to install a steam equalizing line, connecting all vapor phase units at the top, and a water equalizing line, connecting all water inlet lines at the bottom. When so interconnected all idle engines are maintained warm, at about 200 to 210 degrees F., with the steam from the operating engines. The steam flows down the individual engine outlet water and steam line, which contains no water when idle and heats the water in the top of the engine by condensing the steam. As the condensate builds up, the heated water will flow in reverse through the water equalizing lines to the other operating vapor phase units. By this method, the normal water level in both the operating and the idle units

TABLE A

Percent of Engine Load	Steam-Water Ratio
25	90 Pounds of water to each pound of steam
50	50 Pounds of water to each pound of steam
75	27.5 Pounds of water to each pound of steam
100	18 Pounds of water to each pound of steam

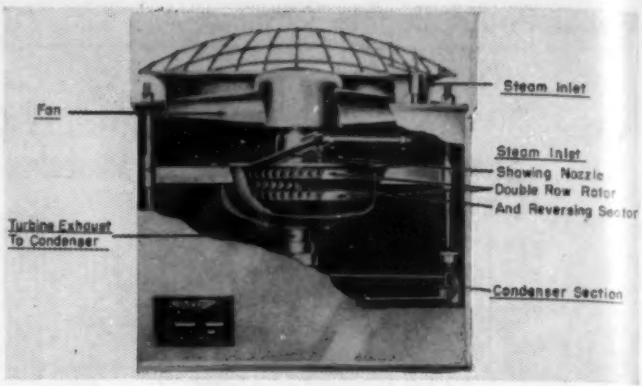


Figure 4. Steam turbine-driven fan condenser.

is maintained. Where one vapor phase unit is used to serve two or more engines, equalizing lines are not required. For large engines, individual vapor phase units are desirable because the size of a central vapor phase unit to serve two or more engines, becomes quite large and the inlet and outlet header lines must be increased in size.

Make-up Water—Vapor phase systems require practically no make-up water except to replace leaks. By the use of high heat resisting cylinder liner and sealing rings, grommets, gaskets and flexible connections, of the plastic type, water leaks can be greatly minimized. If the available make-up water is soft, no scale will form in the engine. If hard, it must be treated to remove the scale forming properties. The engine, like a boiler, must be supplied with good water. If treated water is used, the vapor phase unit must be blown down to remove the solids, in suspension, in the treated water.

Plastic seals, where required in the engine and in any flexible joints in the piping, should be used instead of rubber. High grade plastic material, of the silicone type, that will withstand high temperatures adds very little to the over-all cost of the engine installation, therefore it is recommended over the plain rubber which, in hot water and steam will lose its elasticity, harden and soon cause leaks.

Fuels—In some oil refineries, natural gasoline plants and petrochemical plants, considerable fuel is available that contains H_2S. Such fuels, if the H_2S content is high, are mixed with sweet gas and burned. This fuel can be used safely with vapor phase, without causing accelerated engine wear, because this gas cannot cause acid formation when cooling at the elevated temperatures. Many vapor phase cooled engines have operated for years with untreated sewage sludge gas, oil field and refinery sour gas, all containing a high percentage of H_2S. Diesel engines will operate on fuel oils containing as much as 3 percent sulphur.

Antifreeze Solutions—In mild climates where freezing temperatures are occasionally encountered a portion of the steam condenser should be covered so as to prevent freezing of the condensate. Where hydraulic type or two speed motor driven fans are used, they can be slowed down during cold weather.

In very cold climates the steam condensers should be mounted in a lean-to alongside the engine house. Cooling air may be drawn from inside the engine house and discharged outside through louvers in the lean-to. Another set of louvers installed in the wall of the engine house will

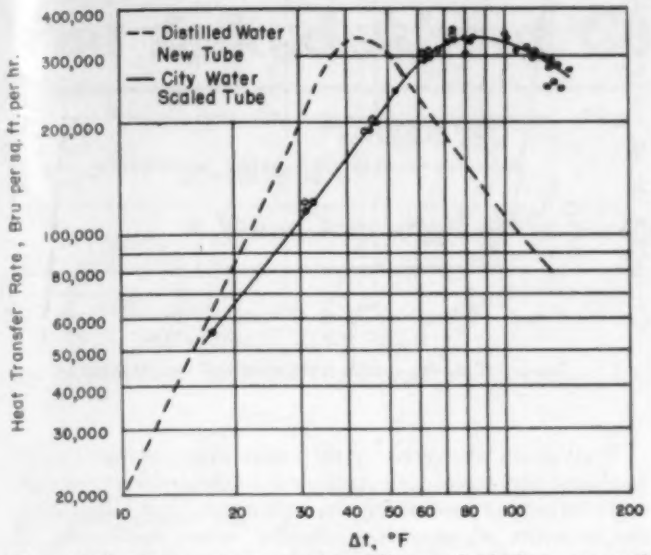


Figure 5. Heat flux versus temperature difference for boiling water and a heated metal surface.

permit heated air to discharge back into the engine house for heating.

Engine Room Temperature—Are engine room temperatures excessively high with this installation? The greatest quantity of heat radiated to the engine room, by a gas engine, comes from the exhaust line which should be insulated in all cases. Insulation of the vapor phase unit, all hot water and steam lines is also recommended. When this is done the engine room temperature will not be excessive. The room temperatures in Table 1 were observed in a gas engine compressor station, where several large engines were operating at 212 F. jacket temperature, with only the exhaust line insulated.

First Cost—The cost of the equipment, including the vapor phase unit, steam condenser unit, with water coil for cooling lube oil, fan and drive is competitive for engines in the range of 500 to 750 bhp. The same equipment is usually less expensive for larger engines. Where hydraulic or electric driven fans are used considerably less cooling air is required due to the elevated temperature, thus fan horsepower is saved.

Vapor Phase Pump Circulation—Figure 2 shows the vapor phase unit, which must be mounted high enough above the engine to insure a positive head on the circulating water pump. As the aerial cooler may not, in most cases, be mounted high enough for gravity return of the condensate, the Condensate Unit C is required, making a more expensive installation.

Special Controls—Figure 3 shows a unit which is designed for unattended engines and where a condensate return unit may be required because the steam is being used in a heating system that is below the vapor phase unit.

The highest float switch, shown at the left, controls the condensate pump. The next lower one controls a standby condensate pump. The next one is the automatic fresh water make-up float valve. In case of failure of both condensate pumps and, at the same time, failure of the fresh water supply, the next float switch will sound an alarm or actuate a signal in the office upon lowering water level. If the cause of the failure of the condensate pumps and fresh water supply is not corrected, the float switch, located below the alarm switch, will ground all engine magnetos, thus stopping the engine.

Steam Turbine Driven Fan—Several years ago we conceived the idea of utilizing the vapor phase steam to drive fans with turbines, thereby cooling engines with their own waste heat.

Shown in Figure 4 is the turbine unit which is complete with fan and a finned coil for condensing the steam. The turbine will automatically start turning the fan as soon as steam is produced. As engine load increases the turbine speeds up, always supplying the correct quantity of cooling air for all engine loadings. When the engine is shut down the turbine does not stop until all residual steam is condensed. During the hot part of the day the turbine will build up about 15 to 20 psig pressure, at full engine load, the pressure reducing to about 5 psig at night or during low load periods. As the steam leaves the turbine it enters the condenser at atmospheric pressure, requiring a condensate pump.

Research—Investigation of heat-transfer with water at boiling temperature explains why even at low coolant velocities a high heat-transfer takes place. The heat-transfer rate at various temperature differences between a heated metal surface and boiling water is shown in Figure 5.

The graph shows the important fact that the heat-transfer rate under boiling conditions depends almost entirely on the temperature difference between the hot metal surface and the boiling point of water. The boiling point of water depends of course on the pressure at which the water flows past the particular location in the cylinder or cylinder head.

In vaporizing, far more heat is abstracted from the metal surface than would otherwise be possible, and an extremely high heat-transfer rate is obtainable with relatively little difference in temperature between the water

TABLE 1

Engine Room Temperatures

LOCATION	Temperature, F.
Ambient Air	84°
6' from power cylinder 30" above the floor	97°
8' from power cylinder 30" above the floor	96°
72" from power cylinder 30" above the floor	95°

TABLE 2

Cylinder Wall Temperatures (F.) for Conventional and Vapor Phase Cooling

Cooling System	Water In	Water Out	Cylinder Wall Position 1	2	3	4
Conventional	148	154	231	220	205	190
Vapor Phase*	206	213	270	261	244	233
Vapor Phase**	209	214	219	217	220	218

* With water pump.
**With thermal circulation.

TABLE 3

Inspection Measurements of 11-Inch Bore Cylinders

CYLINDER		Top 3/4"	Middle 5"	Bottom 10"
No. 1	A.*	11.011	11.0015	11.002
	B.*	11.001	11.000	11.000
No. 3	A.	11.00025	11.99925	11.000
	B.	11.0005	10.999	11.000
No. 3	A.	11.001	11.000	11.000
	B.	11.001	11.000	11.000
No. 6	A.	11.001	11.00075	11.001
	B.	11.003	11.00475	11.007

*"A" is parallel to crank shaft while "B" is at right angles to the crank shaft.

and the metal surface. The small vapor bubbles formed leave the metal surface, mix with the surrounding water and condense unless the entire body of the water is at boiling point as in a pan of boiling water.

The excellent wetting action of the water coupled with its high latent heat of vaporization make it an exceptionally good coolant for this type of cooling.

Cylinder Wall Temperatures—Comparison of metal and water temperatures does not show a significant difference between conventional and vapor phase cooling systems. Typical results are shown in Table 2. The diesel engine used in the first two systems was a naturally aspirated, four-cycle engine with a rated 150 bhp and circulating water rate of 0.7 gpm per bhp. Four thermocouples were sealed in the cylinder metal (on the water jacket side), the No. 1 position being at the top and the No. 4 being at the bottom. It will be noted that the temperature difference between the No. 1 position and the water out is 77 F. for the conventional system and 57 F. for the vapor phase systems with a water pump. In the case of the vapor phase system with thermal circulation, the difference is only 5 F.

Corrosion—Cylinder wear is less at temperatures above the dewpoint as will be noted in Figure 6. In fact the rate of wear is shown to be almost independent of temperature over the range from 212 to 510 F.; but below a temperature of 194 F., there is a rapid increase in rate of wear. This phenomena works to the advantage of vapor phase cooling (operating above the dewpoint) as is borne out by the typical field results shown in Table 3. This inspection data was taken on four power cylinders of an 11-inch bore gas engine-compressor, after 5800 hours of operation. Further, it was observed that the pistons and firing chambers were unusually clean. Adjustment and maintenance time on this unit and two similar ones average approximately 30 percent less than the average unit time spent on all other engine units in this plant that are equipped with conventional cooling systems.

Waste Heat Recovery—The amount of heat recoverable from the jackets of a modern gas engine driven compressor unit such as those in oil refineries and in gasoline plants is, in the order of, 2500 Btu per bhp per hour. From older style gas-compressor units as much as 3000 Btu per bhp per hour is recovered. This heat, in the form of steam, at 20 psig (258.8 F.) is being used in two gas compressor plants in California to treat crude oil. The heat is recovered from one 150-bhp and three 300-bhp gas engines in one station and from one 150-bhp and seven 300-bhp gas engines in the other one. Both have older style engines that consume on the order of 10,000 Btu per bhp per hour.

A temperature control valve, installed in the heated oil outlet line, operates a motor valve to regulate the flow of steam. When the steam pressure builds up to 22 psig the back pressure valve leading to the turbines will open and pass the steam to the turbines, which automatically start and stop the fans.

Where additional waste heat is required, (not required in these stations) an additional 1500 Btu per bhp per hour can be recovered from the exhaust as steam at low pressure or, if required, about 1000 Btu per bhp per hour can be recovered as steam at pressures up to 125 psig.

The quantity of heat recoverable from an engine depends upon the efficiency of the engine. Supercharged engines, that consume 6500 Btu per bhp per hour will produce less than 1000 Btu per bhp per hour from the jackets.

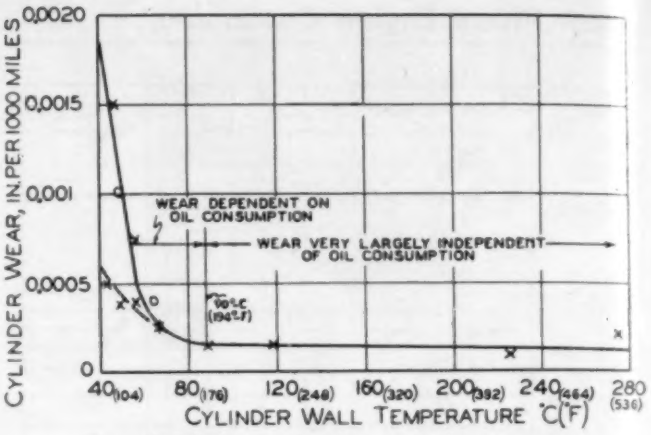


Figure 6. Cylinder wear in relation to wall temperature.

If all steam recovered by the vapor phase system can be used and the condensate returned to the primary circuit, a closed engine cooling system will result, thus eliminating the necessity of providing standby steam condensers. If the process cannot use all of the steam, then the excess steam may either be discharged to atmosphere or standby condensers can be installed if ample soft water is not available for make-up.

It is important to remember that all heat rejected to the circulating water is recoverable in its more useful form, i.e., low pressure steam; and all of it can be used without lowering the temperature of the circulating water below boiling.

Advantages of Vapor Phase Thermal Circulation—(1) Temperature control at all loads is made automatic by the natural law of boiling of the coolants. Thermostats and all other mechanical controls are eliminated.

While the coolant boils all of the time the engine runs, it cannot boil over. As circulating of the coolant cannot commence until it boils, the warm up period is much shorter. Where two or more engines are being cooled, idle engines can be maintained at near boiling temperature indefinitely. Such idle engine can be started and be placed under full load as soon as the lube oil pressure reaches operating level.

(2) Constant temperature, at all loads, is always above the dewpoint of gases, therefore, the water of combustion cannot condense on the cylinder walls, thus acid formation is eliminated, resulting in:

(A) Gas fuel, containing H_2S, or fuel oil containing sulphur, all of which are cheaper, can safely be used.

(B) Cylinder wear, caused by corrosion, is greatly reduced.

(C) Lube oil sludge minimized.

(D) Improved combustion.

(E) A very turbulent flow of water and steam through the jackets.

(3) Circulating water pumps are completely eliminated. Likewise their maintenance and cost of power to drive them.

(4) Proper circulation of water at all loads is automatically controlled by the heat being rejected.

(5) Even expansion of all engine metal, resulting in improved cylinder-piston clearance.

ACKNOWLEDGMENTS

[1] W. H. McAdams, Heat Transmission, McGraw-Hill, New York (1933).

[2] Williams, "Collected Researches on Cylinder Wear," Institute of Automotive Engineers, January, 1940.

You Asked About Corrosion . . .

MARSHALL E. PARKER

• What does a holiday detector test?

By **MARSHALL E. PARKER,** Consulting Corrosion Engineer

Q.—What is the correct holiday detector voltage to use in testing plastic tape? E. P. N.

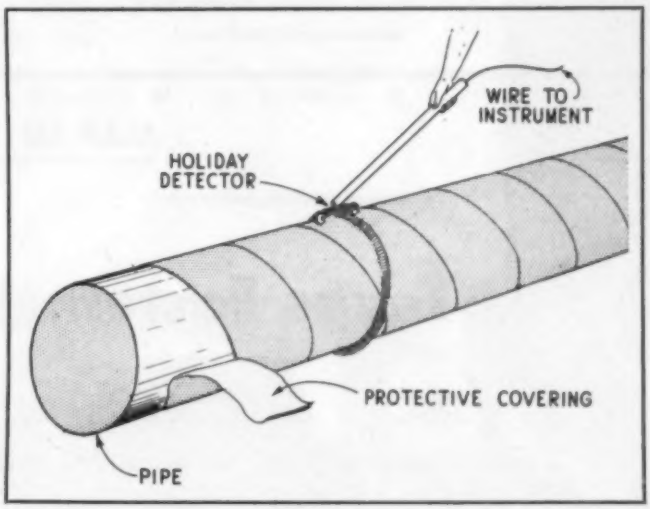
Q.—If a new coating material cannot stand the holiday detector tests we have been using, can it be as good as our present coatings? S. D. H.

A.—These two questions—and several others which have been asked the writer informally—apply to the same basic problem: what does a holiday detector test?

First of all, it must be emphasized that a holiday detector is a continuity tester, and nothing more. High dielectric strength—the ability to stand high voltage without failure—is *not* a necessary requirement for pipe coatings; in actual service, they will never be subjected to high voltages; why, then, should they be so tested? The answer is that advantage is being taken of a property which is accidentally possessed by most coatings, to test for continuity. It happens that practically all materials which have been used as pipe coatings do have a high dielectric strength—not needed—and this makes it possible to locate holes in them by passing a high voltage electrode along their surfaces. Then, when a spark passes, we know that there is a hole, or that there is an inclusion of foreign material which happens to be conductive. Likewise, although it is not the primary purpose, it is inevitable that a holiday detector will find areas which are much too thin.

To determine the correct voltage to use in testing a given coating system, we should proceed as follows. The voltage used should be sufficient to do the following things:

1. Jump an air-gap equal to the specified thickness of the coating system.
2. Jump an additional air-gap to compensate for the electrode configuration; i.e., to allow for the fact that the electrode is not absolutely continuous.
3. Stress to failure some minimum thickness of the material. These requirements determine the minimum voltage to be used. The maximum is determined by the fact that it should not damage the coating when the thickness is the minimum specified as acceptable.



The voltage referred to should be the actual voltage existing between the electrode and the pipe, using the return circuit which is actually going to be used in the field (i.e., drag wire, driven ground, dielectric pad, or other); this will normally be lower than the open-circuit voltage of the detector. It should also be emphasized that the voltage referred to is the peak or crest voltage; not the average or r.m.s. value, which may be a great deal lower than the peak.

The frequency with which the peaks occur should be great enough that the electrode cannot be moved, at normal speed, past the range of a holiday between pulses; this would have the effect of turning the detector off part of the time. It is also important that one of two things be done; either (1) the wave-form should be such that there is not enough energy to damage the coating by heating, or (2) the voltage should never be applied while the electrode is stationary.

It should be recognized that, in effect, all holiday detector voltages are alternating current; this is true even of the so-called pulsating d.c. type. The circuit across which this current is applied is a condenser, with the electrode and the pipe forming the plates and the coating the dielectric; hence some current will be passed, even without any holidays. This has two effects; it tends to heat the dielectric, and it tends to trip the indicator relay on the detector. Plastic tapes are much thinner

than the older types of coating, and thus will pass a much larger condenser (non-puncturing) current; in some cases, the detector relay may trip continuously without there being any spark at all.

A tentative rule for the determination of a correct testing voltage is $V = K\sqrt{T}$, where V = the peak voltage in kilovolts, K is a constant (minimum = 1, maximum = 1.5) and T = the thickness in mils of the bonded coating system (exclusive of unbonded outer wraps).

The plastic tape materials which have been introduced into the pipe coating field fortunately have a very good dielectric strength. This means that they can be tested with conventional holiday detectors (using the above rules); some future material may have every qualification for an excellent pipe coating, but have a low dielectric strength. This will not mean that it is an inferior material; it will merely mean that some other kind of continuity test will have to be devised for it.

To give a more specific answer to the second question, the following idea is suggested: suppose that a very inferior grade of water-soluble still-bottom asphalt were chosen, and applied to a pipe in a thickness of, say, two inches, using a sufficiently high temperature to temporarily drive off all moisture. Such a coating would stand a holiday detector test of perhaps 100,000 volts—far higher than we ever use; would this prove it to be a superior coating? The answer, of course, is no; it would actually be very poor, since it would absorb moisture and disintegrate quickly; *its good showing would be due entirely to its great thickness.* In exactly the same way, the apparently *poor showing of plastic tape is due entirely to its great thinness.*

If it is sufficiently superior to conventional coatings in other respects, as they are superior to the imaginary dope mentioned, then it may well be a very superior coating. The important thing to cite here is that the holiday detector does not give us the answer to that question.

—The End

MAP OF THE MONTH

Texas Eastern Is Still Expanding

Texas Eastern-Penn Jersey's 265-mile 24-inch line scheduled for completion in November is the latest addition to vast network that began in 1947.

THE MOST RECENT expansion program for a company which has been continuously engaged in the process of expansion since its inception in 1947 was approved by the Federal Power Commission on April 29 of this year. A subsidiary of Texas Eastern Transmission Corporation, Texas Eastern Penn-Jersey Transmission Corporation, was authorized in this approval to construct a 265-mile 24-inch pipe line from the Oakford Storage field near Pittsburgh to the parent company's compressor station near Lambertville, N. J.

The major portion of the rights-of-way work had been previously completed, and construction was started immediately.

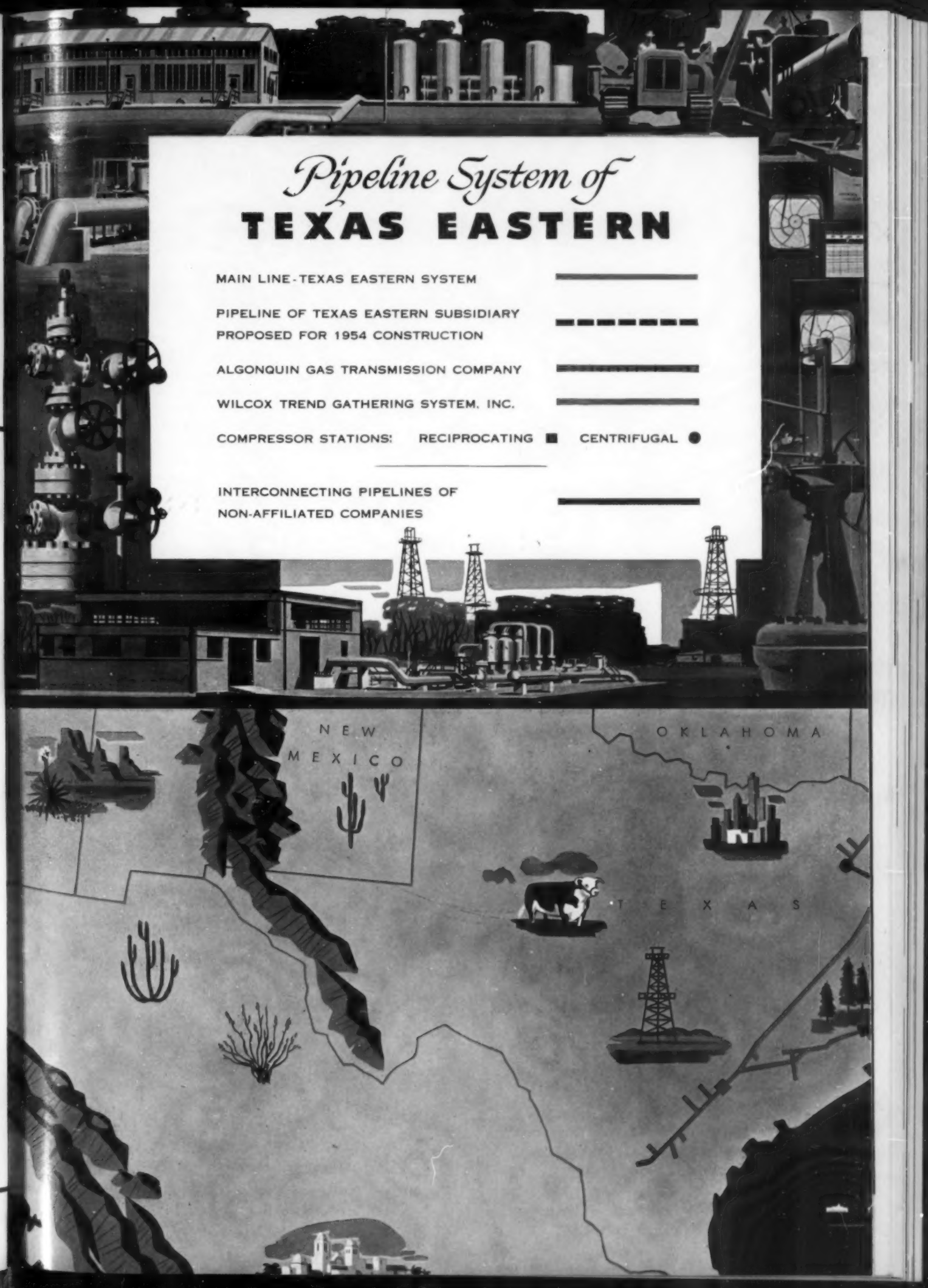
The contracts for construction were awarded on the basis of five spreads. H. C. Price Company of Bartlesville, Okla., received the contract for the first spread, totaling 54 miles. The second spread, 44 miles, was awarded to Western Pipeline Constructors, Inc., of Austin, Texas. The remaining three contracts for 49, 58 and 58 miles respectively are being handled by Williams Brothers Company of Tulsa.

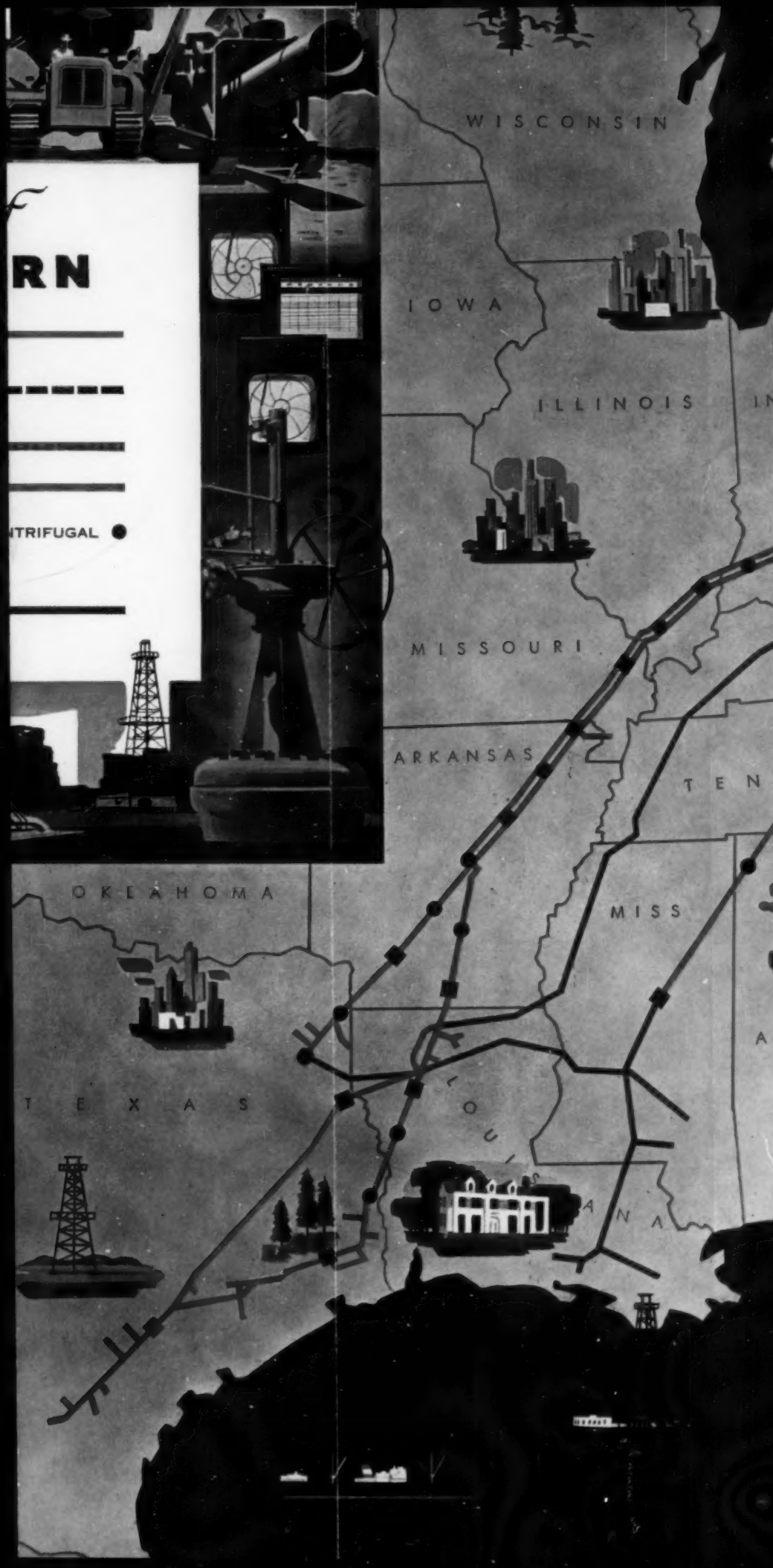
There will be five river crossings, each double-laid with one 24-inch line and one 16-inch line. Contracts for the Conemaugh, Juniata and Susquehanna rivers were awarded to Pentzein, Inc., of Omaha, Nebr. The Missouri Valley Dredging Company, of Omaha, received contracts for the Schuylkill and Delaware rivers.

Also included in the FPC approval was one 3300 horsepower compressor station near Delmont, Penn. Mid-Valley Utility Constructors, Inc., of Houston was awarded the contract, and construction started shortly thereafter.

The cost of this new line is estimated at $31,000,000, and construction is expected to be completed by November, 1954. When completed the line will have a delivery capacity of 204 million cubic feet of gas a day, and will be leased to and operated by Texas Eastern Transmission Corporation.

Texas Eastern Penn-Jersey Transmission Corporation was incorporated to implement an agreement between Transcontinental Gas Pipeline Corporation and Texas Eastern Transmission Corporation concerning a storage service for Transcontinental by Texas Eastern. Under a 20-year contract Texas Eastern will store 12 billion cubic feet of natural gas per year for Transcontinental, delivering the gas to Transcontinental in the winter at a daily maximum rate of 133.5 million cubic feet and receiving redelivery of


Pipeline System of
TEXAS EASTERN
MAIN LINE - TEXAS EASTERN SYSTEM
PIPELINE OF TEXAS EASTERN SUBSIDIARY PROPOSED FOR 1954 CONSTRUCTION
ALGONQUIN GAS TRANSMISSION COMPANY
WILCOX TREND GATHERING SYSTEM, INC.
COMPRESSOR STATIONS: RECIPROCATING ■ CENTRIFUGAL ●
INTERCONNECTING PIPELINES OF NON-AFFILIATED COMPANIES
NEW MEXICO
OKLAHOMA
TEXAS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KENTUCKY
NORTH CAROLINA
TENNESSEE
SOUTH
CAROLINA
ALABAMA
GEORGIA
FLORIDA

Texas Eastern today . . . 39 compressor stations and over 4500 miles of line

the gas from Transcontinental during the summer months. Transcontinental has agreements with seven of its customer companies in the New York, New Jersey and Philadelphia areas, providing for delivery of the gas to such companies under similar terms.

This agreement will permit greater use by Texas Eastern of its interest in the Oakford Storage pool and will make no new demands on Texas Eastern's gas supplies or reserves. Conversely, residential customers of the Transcontinental's distributing companies will benefit substantially from the proposed program because it will make available to them for winter space heating large volumes of gas which otherwise would have been consumed in the summer months as boiler fuel and for other industrial purposes.

On the basis of recently completed studies, in July, 1954, Texas Eastern filed an application with the FPC for leave to withdraw a major portion of the Little Big Inch pipe line from natural gas service and for authority to construct substitute gas-carrying facilities.

The company's purpose in so doing is part of a plan which provides first for modification of its gas transportation system to achieve greater efficiency and flexibility and at the same time withdraw certain of the present gas facilities to permit the reconversion of approximately 1,100 miles of the Little Big Inch line from gas service. The line to be reconverted to the carrying of petroleum products extends from the Beaumont, Texas, area to Moundsville, W. Va. The converted 20-inch line will be capable of transporting up to 235,000 barrels of oil products daily. This will make it one of the nation's major common carrier systems for the transportation of refined oils.

The plan of conversion includes the construction of at least two tank terminals, one on the Ohio River near Moundsville, W. Va., and a second on the Mississippi River near Cape Girardeau, Mo. The construction of lateral lines to existing tank terminal facilities near Shreveport, La., and Louisville, Ky., is also contemplated.

As a gas carrier the 20-inch line has a capacity to move approximately 200 million cubic feet daily out of Texas Eastern's total system capacity of about 1.2 billion cubic feet a day. To replace this 200 million cubic feet capacity Texas Eastern plans to construct a 24-inch diameter line extending from Beaumont to Kosciusko, Miss. In addition approximately 30 miles of 20-inch pipe line will be constructed in the Baytown-Beaumont area plus a few miles of smaller size feeder lines. Present plans include the addition of 84,100 compressor horsepower at various points along the system.

These new facilities will shift the Little Big Inch gas capacity into the 30-inch line out of Kosciusko, boosting the capacity of the 30-inch system from about 385 million to approximately 600 million cubic feet of gas daily.

An an initial step into refined oil products transportation, a Texas Eastern subsidiary, Texas Eastern Production Corporation, purchased all of the outstanding common stock of Triangle Pipeline Company on an advance from the parent company. Triangle, a sound investment in itself, will tie in with the projected Inch products system. Triangle now transports petroleum products from gasoline plants and refineries in East Texas, North Louisiana and South Arkansas through its line terminating on the Mississippi River at Arkansas City, Ark.

Texas Eastern also filed in July an application with the FPC for the construction and operation of 58 miles of 20 and 16-inch natural gas pipe line to extend from Joaquin to Longview, Texas. This construction would permit gas from the company's lines originating at Provident City, Texas, to be transferred to its 24-inch pipe line originating at Longview, Texas, whereas at present the company has no facilities south of Little Rock, Ark., for transfer between those lines. This construction will consist of 26.5 miles of 16-inch pipe line extending from the company's compressor station near Joaquin, Texas, to the Carthage field in Panola County, Texas, and 31.5 miles of 20-inch pipe line from the point of termination of the 16-inch pipe line to the south terminus of the company's 24-inch pipe line near Longview. The cost of the project is estimated at $3,269,000.

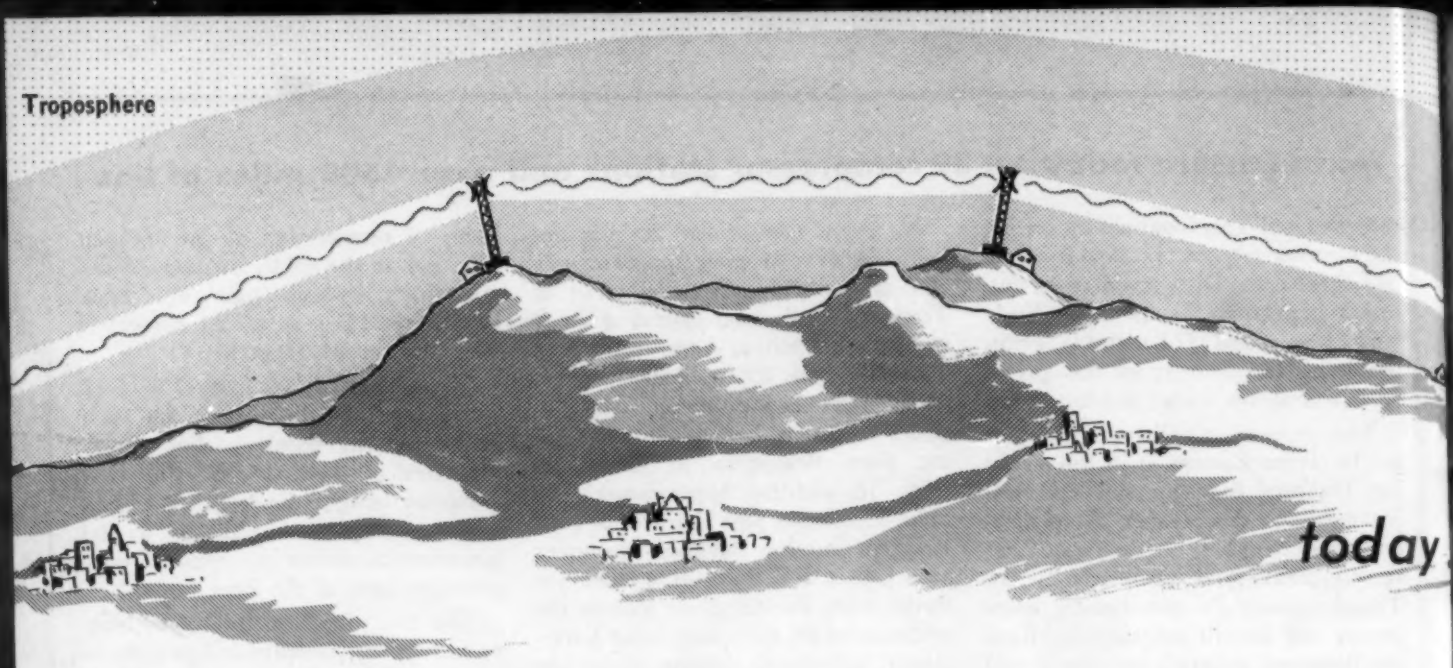
Texas Eastern was formed in 1947 to bid on the war surplus Big Inch and Little Big Inch pipe lines. With an offer of $143,127,000 this new company bought the Inch pipe lines, a transaction which returned to the government almost the original construction costs of the lines.

The two pipe lines, originally built to transport petroleum and petroleum products to the East Coast were converted to the transmission of natural gas, and by the end of 1947 the company's delivery capacity was 235,000 MCF per day. One expansion program followed on the heels of another, and new compressor stations and additional supply, lateral and looping lines brought daily delivery capacity to 740,800 MCF. In 1951 still another expansion program, consisting of 774 miles of 30-inch pipe to extend from Kosciusko to Connellsville, Penn., was undertaken and its completion in 1952 brought Texas Eastern's pipe line system to a total of more than 4200 miles and its delivery capacity to more than 1.2 billion cubic feet of gas per day.

A new subsidiary, Wilcox Trend Gathering System, Inc., added another major source of supply to Texas Eastern's system when the Wilcox lines began operations in South Texas on August 1, 1953. In order to handle this gas and possible additional supplies from other producers in the area Texas Eastern built a 307 mile 24-inch line extending from Provident City, Texas, to Castor, La.

Texas Eastern in 1950 joined New York State Natural Gas Corporation as a co-equal partner in the development of underground storage facilities in an area of about 19,000 acres not far from Pittsburgh, Penn., known as Oakford Storage. This storage field will ultimately provide storage for 105 billion cubic feet of natural gas for the two corporations.

Today the company has 39 compressor stations and more than 4500 lines of pipe line. **—The End**



What's Ahead in Communications?

Every now and then there comes from the research laboratories a glimpse of things to come. Here's what an expert predicts for petroleum communications.

By DANIEL E. NOBLE,
Vice President, Communications and Electronics Division, Motorola, Inc.

NOW AVAILABLE for application are all of the necessary electronic, electrical and servo-mechanism devices necessary for central supervision of a pipe line, partial automatic control with supervision, or fully automatic operation of a pipe line transportation system.

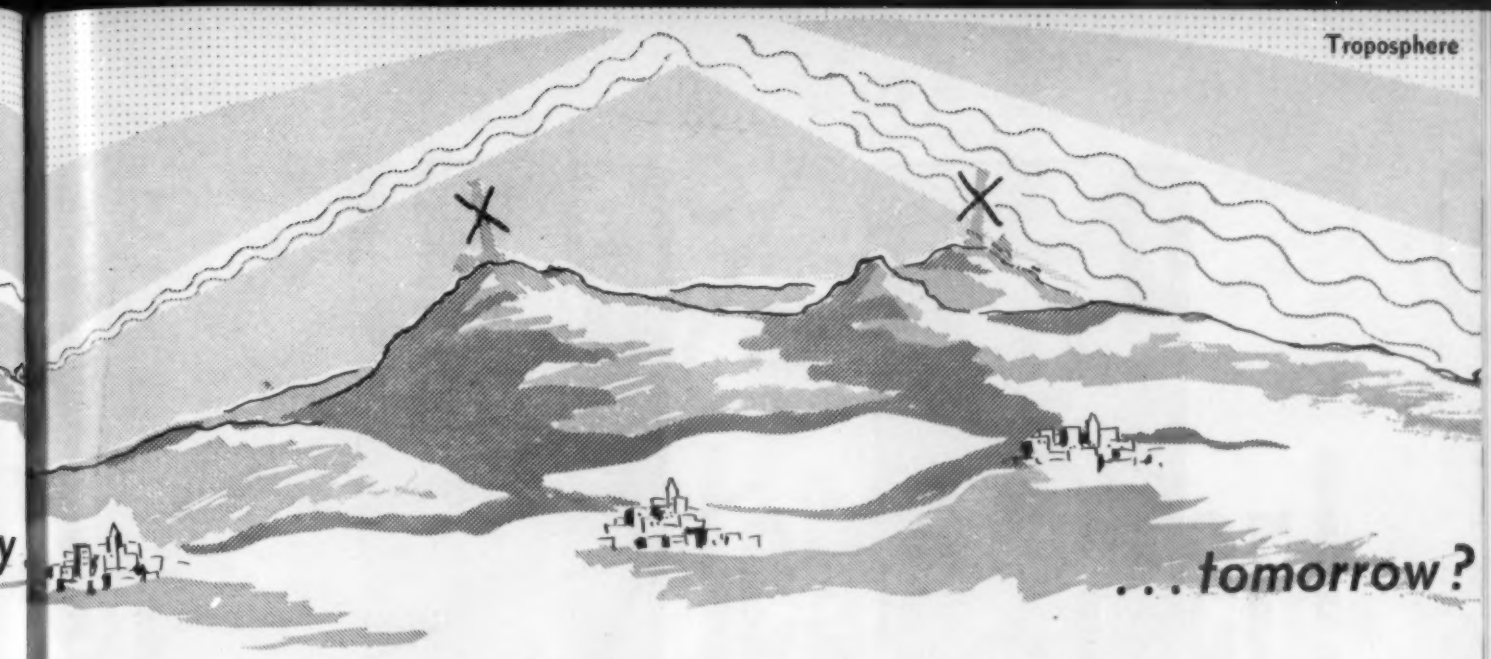
By means of telemetering and feedback systems, information flow can provide controlling codes, both indicating and controlling pipe line pressures at pumping stations and at any intermediate points along the line. The control of valves, pumps, safety devices, and the recording of rates of flow with added automatic control of distribution and even of customer billing is possible. By means of memory storage devices, such as magnetic drums, magnetic tape or punched cards, or punched tape, the programming of product flow through the pipe line, as well as product distribution, could be handled on an automatic basis. The microwave system provides the basic communication means, and the full economic utilization of such a communication link cannot be achieved without integrating it into the over-all systems operational concept. There must be freedom to choose the channels, codes, and code characteristics required to develop automatic control.

The limits to the degree of automatic control for the operation of a pipe line transportation system are not found in scientific or engineering limits, but only in the limits to be determined by the cost of the refinement to be achieved by electronic control applications when weighed against the reduction realized in the cost of transporting each barrel of fluid. An intelligent operational research program carried out in relation to a pipe line transportation system will surely disclose substantial areas for the application of electronic automatic control which will yield dollar savings.

New Radio Propagation. There is a comparatively new form of radio propagation which holds promise for application to pipe line systems. A form of electro-magnetic wave propagation, referred to as "forward scattering," has been explored over the past few years with very interesting results. Tropospheric forward scattering is a form of radio wave dispersion in the lower atmosphere not unlike the scattering of light when illuminating areas behind barriers in the path of the light source.

In the past, it was thought that the magnitude of the signal provided by such scattering below line-of-sight was of such low level that it would be unusable for communications. Investigation during the past few years has disclosed that the actual signal level is literally thousands of times greater than that predicted by conventional theory. By using high powered transmitters and directional antennas at both ends of a circuit, it has been possible to provide excellent continuous communication between points as far distant as 200 or 300 miles, using frequencies in the microwave band and transmitting over paths in which the curvature of the earth and the presence of mountains made the line-of-sight reception of the direct wave quite impossible.

There is much yet to be known about this newly-discovered phenomenon, but the transmission seems to take place with little dependence upon the frequency of the transmitters and with little or no influence by mountains in the path of communication. If the promise of forward scattering is fully realized, the location



of microwave stations at the pumping stations may be possible, and by means of high power transmitters and directional antennas, communications may be provided without resorting to the use of relay units installed in locations where there are neither road nor power facilities.

It is too early to predict that this will come to pass, and it is possible, because of increased cost of high power transmitters, that the economics may utilize such a transmission system only where road and power facilities make the use of relay units impracticable. It is too early to predict the extent to which forward scattering will be used in the petroleum communication field, but this beyond-the-horizon transmission is most encouraging and it shows remarkable potential for future utilization.

Solid State Physics Research. Another field of potential importance to petroleum communications is found in the area of solid state physics research. The understanding of the laws governing matter in the solid state has lagged behind the comprehension of the laws influencing matter in the liquid and gaseous states. This is understandable, since we can, figuratively, get inside of matter in the gaseous or liquid state and we can test and measure and study its characteristics. Getting inside of solid matter is more difficult, and the actual application of solids in industry, using empirical methods, has moved out ahead of our scientific knowledge of the structure of solids. In the past ten years, the physics of the solid state has advanced markedly, and particularly our knowledge of solids in the crystalline form.

One direct result of this increase in comprehension in the field of solid state physics has led to the development of the transistor. This is a semiconductor device usually made of a tiny piece of germanium containing suitable impurities, such as indium. This material, fabricated in the form of a junction transistor, exhibits the characteristics of a triode vacuum tube. In other words, this tiny device, in some forms no larger than the head of a pin, can produce amplification and generate alternating currents by oscillation just as a vacuum tube does. With this tiny device can be built radio broadcast receivers, television sets, mobile receivers, carrier current devices, telephone amplifiers, and thousands upon thousands of other devices, including digital computers and analog computers.

The design and the applications of the transistor have not been fully explored, but there is promise that it will provide a substantial increase in the reliability of electronic amplifiers and oscillators. Equipment using transistors may be designed to work with much lower consumption of power, and may be designed much smaller in size. As the transistor is developed to the full level of its promise, mobile communications receivers without vacuum tubes will be built. They will operate directly from the 6 or 12-volt supply without the use of a vibrator or other high voltage power supply. The expectation is that 40,000-hour life will be nominal for a transistor. A substantial increase in the reliability and a decrease in the maintenance requirements for future mobile units can be anticipated.

Mobile equipment of the future, using transistors, will have a standby 6-volt current drain between 1 and 3 amperes, in place of the usual 6 to 12 amperes. With tubes, the lower drain usually requires compromises which reduce the factors of safety in equipment operation. With transistors, the reduced drain will be achieved without compromise with performance. The transistors are not ready for mobile radio application today, because of problems of high frequency performance, of inherent noise control, and of power output at the high ambient temperatures encountered in practice.

Since a few successful transistors have been made with low inherent noise, others have worked successfully in the VHF frequency band, and some have operated with power outputs of 1 to 15 watts, it is known that the potential for the development of suitable mass-produced units exists. Whether two years or five years of further development is required, ultimately many transistors will be used in mobile equipment to reduce drain and increase reliability of performance.

It should be made clear that there is nothing inherent in the transistor characteristics which will give better communications than is possible now with vacuum tubes. Communication will not be clearer, nor will it be possible to cover greater range. The improvement will be in reduction in power drain from battery, increased

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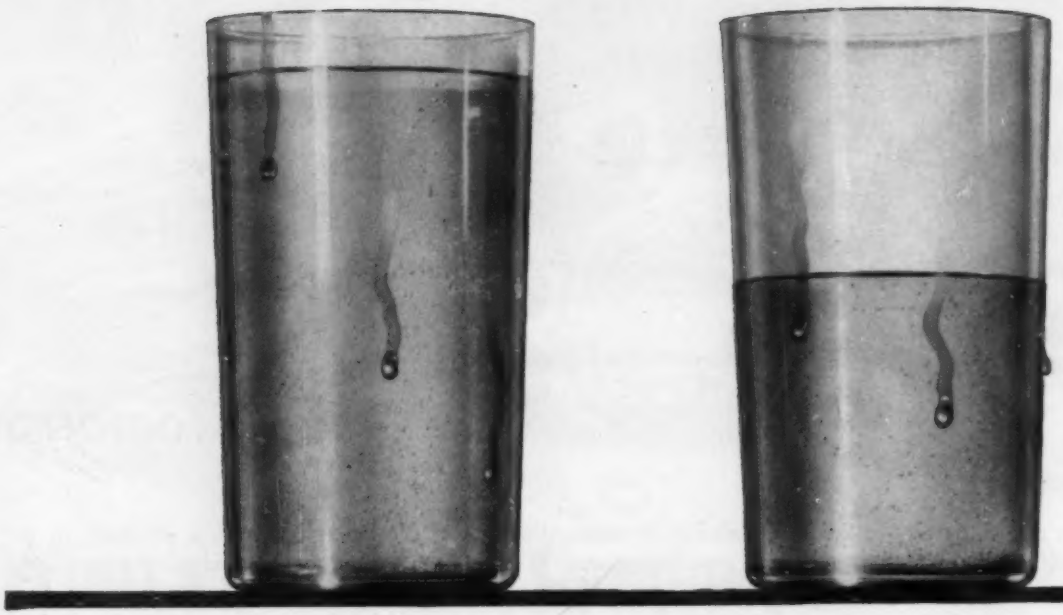

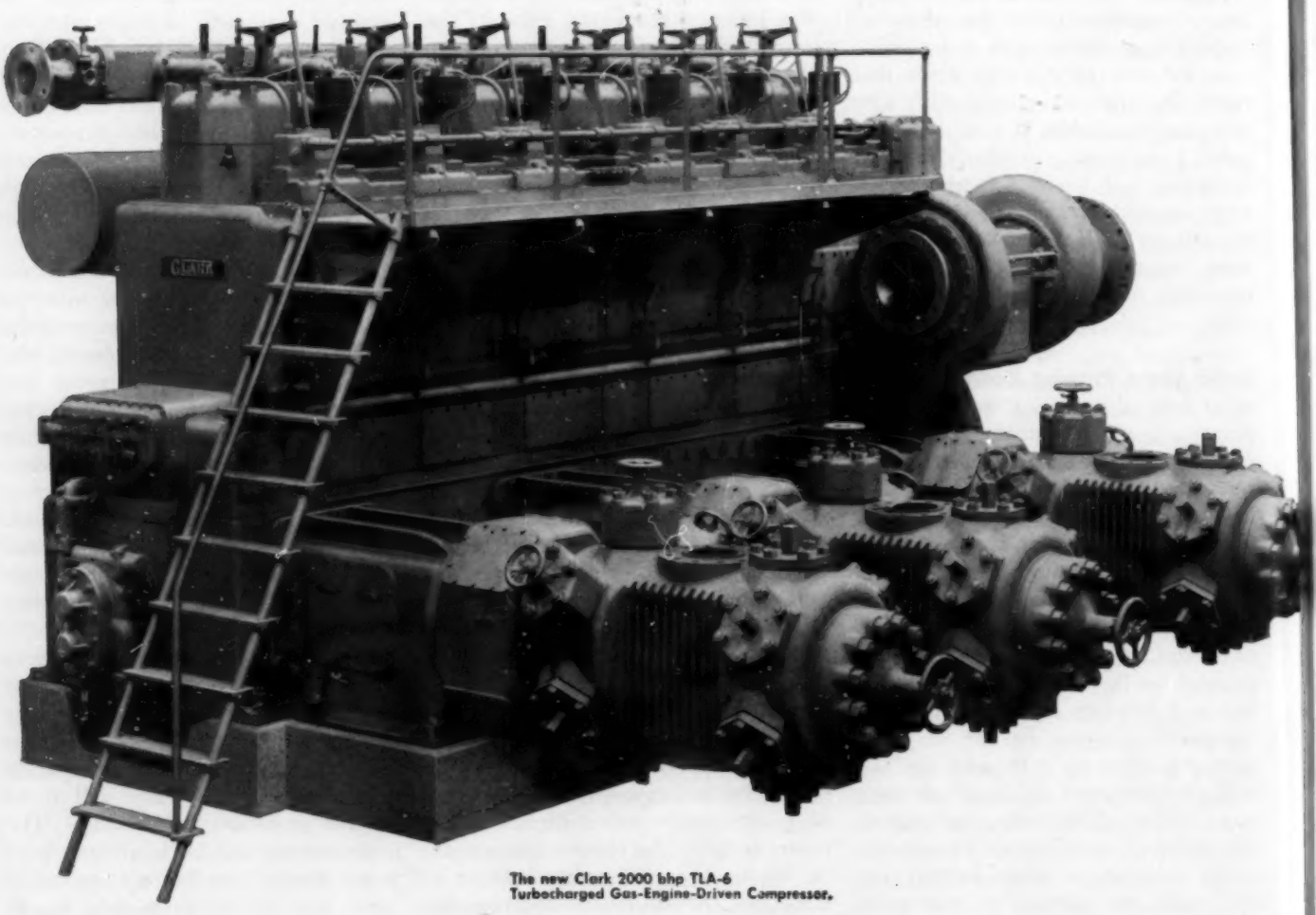

The new Clark 2000 bhp TLA-6
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40% reduction in cooling water rates over comparable non-turbocharged compressors — that's what you save with Clark 2-Cycle Turbocharged Compressors. It's not hard to realize, of course, what big savings this will mean in your installation and operating costs.

How is this tremendous reduction in cooling water requirements made possible? Because these new Clark Compressors operate at higher thermal efficiency, much of the heat which was formerly rejected to the cooling water is now converted to useful work. Translate this into direct benefits, such as smaller cooling towers, fewer wells, smaller pipes and pumps, less water treating materials — and you can easily figure your own savings in installation and operating costs.

Add these savings to those that come from a 12½% reduction in fuel consumption, a 25% to 30% reduction in foundation and building costs — plus many other highly important features — and you'll quickly conclude that this is the most economical compressor to install and to operate.

Simple and dependable, like all Clark 2-Cycle "Angle" Compressors, the Turbocharged Models TRA and TLA are available in sizes ranging from 825 to 3300 bhp.

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BOULDERS WERE HURTLED down the mountainsides in the 1952 earthquake in California, one of the most severe in that state's history. At foot of mountain is aerial span of Pacific Gas and Electric Company's 34-inch line.

How an Earthquake Affects a Pipe Line

Troubles are not over when the initial shock ends. The after-effects can be disastrous, too. Here's how one West Coast company weathered one of the most severe temblors in that area's history.

By R. J. LIND, Pacific Gas and Electric Company

THE MORNING of Monday, July 21, 1952, brought with it one of the most severe earthquakes ever experienced in California. Registering a magnitude of 7.5 on the open Richter magnitude scale, the Arvin-Tehachapi earthquake almost matched the intensity and magnitude of the San Francisco earthquake of 1906. On the Richter scale, a measure of the total energy dispersed, the San Francisco disturbance registered 8.2.

The earthquake originated on the White Wolf fault in the southern end of the San Joaquin Valley. The White Wolf fault had been dormant for nearly 100 years. The epicenter or source of the quake, near Wheeler Ridge, about nine miles from the Pacific Gas and Electric Company pipe line, was in a point of weakness ten miles deep in the earth's crust. Here, centuries of pressure between two large crustal blocks finally overcame friction which had been locking them together. The bedrock slipped and the southern block lurched upward from 5 to 15 feet in relation to the northern one as the spreading crack raced from west to east at nearly 10,000 miles an hour. On the surface there were many landslides, the ground cracked and lurched, powerful shock waves went in all directions and vertical displacement was 1 to 3 feet.

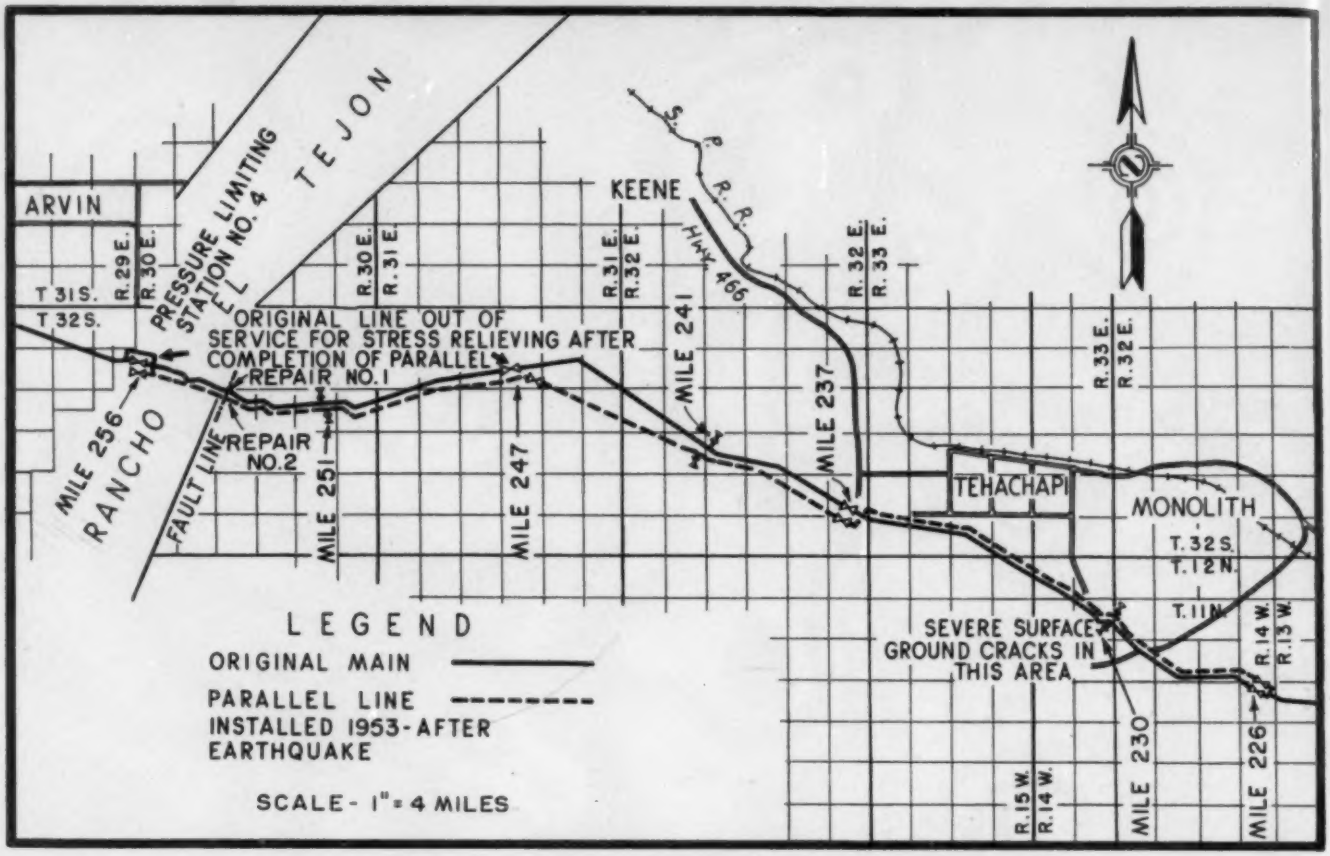
The main shock however, is only part of the story. The other part is the quake's aftershock—nature's way of relieving strains not removed by the initial movement. Four of these have been plotted to the north, south, east and west of the White Wolf fault. The fourth group of movements began on July 29, along a line passing some five miles from downtown Bakersfield. Of these, the first jolt, along with a much weaker one on

AFTER THE QUAKE the first stress-relieving consisted of cutting the line at the overbend. All cuts were made with beveling machine. The line "jumped" four inches when taken out of service and cut.

GROUND WAS DISPLACED 18 inches vertically during earthquake. Photo was taken 200 feet from PG&E's line.

AERIAL SPAN was twisted more than one inch due to rotary motion of earth caused by earthquake.

LINE WAS UNCOVERED at point of greatest earth slippage. Later line was cut and re-welded to relieve stresses.



RECORD OF MOVEMENT OF PIPE AT FAULT ZONE

August 22, but virtually beneath the city, caused damage to the extent of tens of millions of dollars and killed two persons in Bakersfield.

The White Wolf fault crosses PG and E's 34-inch pipe line in the Tehachapi Mountains six miles southeast of Arvin (see map). However, effects of the earthquake were noticeable along the main for 43 miles.

Emergency measures. Following the initial shock at 4:52 a.m., immediate action was taken to put into effect the emergency procedures prescribed in operation orders. The company's private telephone system was disrupted. Commercial communications were used. All compressor stations were instructed to check pipe line flowing pressures for normality. After confirming that line pressures both upstream and downstream of the earthquake area were normal, it was assumed that, at least temporarily, there was no outage at Tehachapi.

Personnel were dispatched to various out points along the line in order to establish radio communication between the Hinkley and Kettleman compressor stations. Telephone repairmen were sent to locate trouble, and pipe line employes began to patrol the line both on foot and by vehicle. Patrolmen found the telephone wires wrapped around each other where cross arm construction had been employed in the area. Complete service was restored at 12:35 p.m. July 21, less than eight hours after the initial shock.

Pipe line personnel patrolled the gas main continuously throughout the Tehachapi Mountains and checked for signs of leaks and strains. By the time the earthquake emergency was declared past, the pipe line had been patrolled and checked for 354 miles. The patrol revealed some severe cracks and several minor earth slashes near, or crossing, the pipe line. No leakage or pipe damage was encountered, however, and routine patrols were put into effect.

The primary problem which presented itself was in regard to continuing operation of the line. Having no immediate physical means to observe what had happened to the pipe some 30 inches beneath the ground, it was assumed that there must be horizontal and vertical strain present. In fault-slip earthquakes, there are not always enough surface indications to trace actual underground movements. Cracks or vertical displacements may be below ground and not show up on the surface for some time.

Assuming this was the case, the gas purchase rate was cut from 400,000 mcf to 300,000 mcf per day. This cut resulted in an average pressure reduction of 200 pounds per square inch in the area most affected by the earthquake.

The pipe used in the Tehachapi Mountains is 34-inch outside diameter with ⅜-inch and 7/16-inch wall. The minimum transverse yield strength is rated at 48,000 psi and

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SALT WATER INSIDE, TRAFFIC VIBRATION OUTSIDE— REINFORCED PLASTIC PIPE STAYS ON THE JOB

Salt water disposal lines run under the streets in Oklahoma City, where wells are located within the city limits. When steel pipe corroded, it was replaced by cement-asbestos pipe. After a few months, traffic vibration caused failure, and the streets had to be torn up again.

In September, 1951, 4½ in. O.D. "Fibercast" Thermosetting Reinforced Plastic Pipe was installed. It has remained in continuous, trouble-free operation ever since. Its BAKELITE Polyester Resin—glass-fiber construction is highly inert, mechanically strong, and shock-resistant. Corrosion and vibration problems are gone.

The same "Fibercast" pipe can carry gas, hydrogen sulphide-laden crude oil, and acid muds—needs no coating, wrapping, or cathodic protection. Its inner surface stays smooth, minimizing paraffin build-up, providing greater flow, and permitting the use of smaller diameters. Flow is even, with settling, surge, and back pressure reduced.

A 20-foot length of "Fibercast" pipe is light enough for one man to lift alone. Installation is fast, handling costs are low. Since the BAKELITE Polyester Resin is thermosetting, heat won't soften it. The pipe won't shatter, yet a hacksaw cuts it easily. Fittings and couplings for "Fibercast" pipe are also made of glass fibers and BAKELITE Polyester Resins, and have the same features.

"Fibercast" thermosetting reinforced plastic pipe is made by **Fibercast Corporation**, Sand Springs, Okla., and distributed by the **Youngstown Steel Products Co.**, **The Continental Supply Co.**, and **Youngstown Steel Products Co.** of California.

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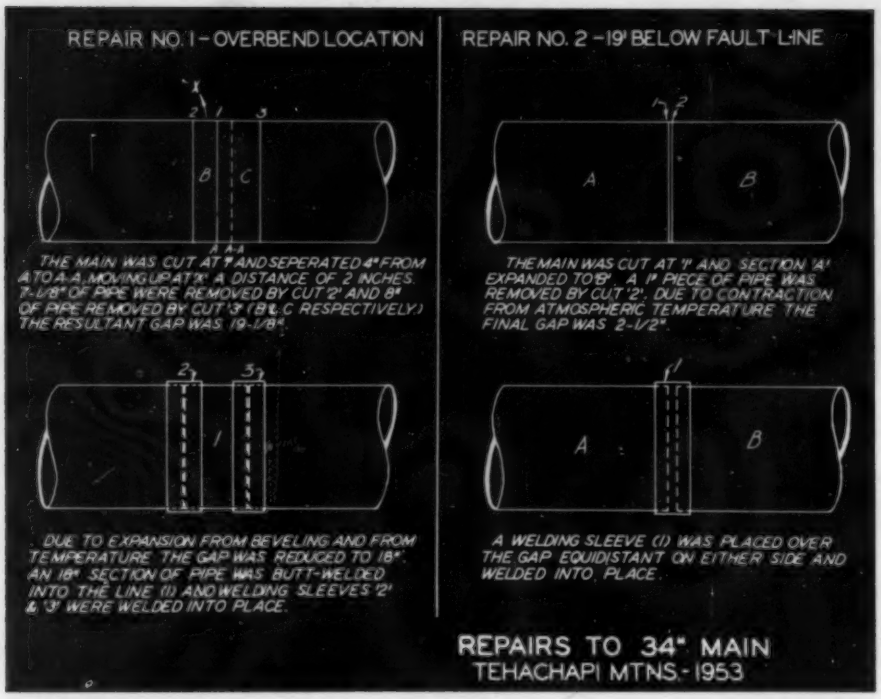
REPAIR NO. 1 – OVERBEND LOCATION
REPAIR NO. 2 – 19' BELOW FAULT LINE
THE MAIN WAS CUT AT 1 AND SEPERATED 4" FROM A TO A-A, MOVING UP AT 'X' A DISTANCE OF 2 INCHES. 7-1/8" OF PIPE WERE REMOVED BY CUT 2' AND 8" OF PIPE REMOVED BY CUT '3' (B & C RESPECTIVELY) THE RESULTANT GAP WAS 19-1/8".
THE MAIN WAS CUT AT '1' AND SECTION 'A' EXPANDED TO 'B'. A 1" PIECE OF PIPE WAS REMOVED BY CUT '2'. DUE TO CONTRACTION FROM ATMOSPHERIC TEMPERATURE THE FINAL GAP WAS 2-1/2".
DUE TO EXPANSION FROM BEVELING AND FROM TEMPERATURE THE GAP WAS REDUCED TO 18". AN 18" SECTION OF PIPE WAS BUTT-WELDED INTO THE LINE (1) AND WELDING SLEEVES '2' & '3' WERE WELDED INTO PLACE.
A WELDING SLEEVE (1) WAS PLACED OVER THE GAP EQUIDISTANT ON EITHER SIDE AND WELDED INTO PLACE.
REPAIRS TO 34" MAIN
TEHACHAPI MTNS.-1953

HOW THE STRESSES WERE RELIEVED IN LINE AT FAULT ZONE

minimum transverse ultimate strength is 65,000 psi. Maximum allowable operating pressure in the Tehachapi area where most of the pipe is 7/16-inch wall had been set at 790 psi, or 64 percent of minimum yield strength. The pressure was reduced to 450 psi and this, in turn reduced the stress on the pipe to only 36 percent of its minimum transverse yield strength. The unknown and indeterminate factor was the stress caused by earth movement.

In order to be advised of any abnormal pressure condition, personnel were stationed on 24-hour duty at key valve locations. They observed line pressures at 15-minute intervals and noted the time and relative intensity of the aftershocks. These readings and observations were relayed twice each hour to the emergency headquarters in Tehachapi.

Attendants at key valve locations carried written orders to follow should communications fail when the line showed a decrease in pressure. Orders were also given to all involved personnel to clarify their duties and responsibilities in event of pipe line failure.

During the patrols it was ascertained that no leaks or cracks had occurred during the initial quake or in the course of the aftershocks. Severe surface ground cracks were discovered, however, along the main line immediately southeast of Tehachapi. Several of these cracks crossed the line and constant vigilance was maintained at such locations. Many open spans were in jeopardy from large boulders on the upper sides of hills. As an example of what might have happened, a boulder estimated to weigh eight tons rolled down one hillside and came to rest on the patrol road less than 100 feet from one such span.

It was discovered that gauge and pressure-control lines were distorted, strained and twisted at Pressure Limiting Station No. 4. These lines operate the pressure-control valves and could have caused an immense loss of gas had they been ruptured.

Surface indication of the fault crossed the pipe line at approximately mile 254. This location is at the bottom of a hill which has vertical angulation of 16¾ degrees. A less severe crack also crossed the line about 410 feet to the east of this point. Vertical displacement of the ground 200 feet south of the line was approximately 18 inches, and immediately north of the line along the fault about 5 inches. Extensive patrolling was instituted along this section in an effort to locate any potential landslides. No further surface disturbances have been discovered in the vicinity to date.

The big job was to determine what, if any, strain had been transferred to the pipe line at the fault crossing. When the fault had first been located, immediate attention was given to a method of alleviating the situation. The first step was to uncover the line. When the first 160-foot section of the line was exposed, it had lifted 6¾ inches. This opening extended from 10 feet above the fault line to 150 feet below it. A section of line approximately 560 feet in length was opened and, with the aid of jacking and blocking, the line lifted 28⅜ inches. This vertical movement occurred on the pipe line 30 feet below the fault crossing and the amount of lift tapered quite rapidly toward each end of the exposed line.

The next major problem was the question of what steps to follow to reduce stresses set up in the pipe line. Every conceivable method of stress-relieving while in service was reviewed and discarded. It was finally decided that there was no satisfactory way of relieving the line without a complete shutdown. But this would be difficult and expensive.

The over-all construction program of the Topock-Milpitas gas system called for a 34-inch loop to be installed between mile 226 and mile 256 during the succeeding year. In the light of these plans, it was finally decided to leave the main in use as it was until this loop could be put in service.

Emergency measures and foot patrols were discontinued on July 29, 1952. The 100,000 mcf per day rate cut of July 21 was discontinued on July 28. A final foot patrol on the following afternoon covered a 51-mile section. Line pressure was then near the operating maximum. No condition was found to indicate the line should not be continued under normal use. However, observation was continued at regularly-scheduled intervals at the fault line and the main was blocked as it lifted. Occasional levels were run to determine any surface or pipe movement. These procedures stayed in effect for nearly one year.

The proposed 30-mile loop was

completed and put into service June 24, 1953. At this time plans made during the preceding summer were put into effect. Excavating was completed, equipment and material were moved to the area. Jacks were installed, butted-in from the trench sides to the pipe, to prevent any lateral movement. The original main was taken out of service from mile 247 to mile 256 and blown down to atmospheric pressure. Actual repair operations were then commenced.

The first stress relieving consisted of cutting the line at the overbend location on the hilltop. All cuts were made with a beveling machine. The top six inches of metal, equidistant on either side of the longitudinal seam, tore apart when the cutting machine reached that point. The pipe sections separated horizontally 4 inches and showed a vertical displacement of 2 inches in relation to one another. This separation gives some idea of the strain borne by the pipe.

In order to repair this portion of the line it was necessary not only to align the pipe but also to make additional cuts and insert a "pup" in the main.

A section of 34-inch OD pipe, 18 inches long with 7/16-inch wall thickness, was butt-welded into the line, and welding sleeves, 34-inch ID, 10 inches wide and having a wall thickness of 7/8 inch, were placed around each end of the 18-inch section and arc welded in place.

The second stress-relieving work was done at a point 19 feet below the fault crossing. The pipe line was cut the same as at the first location. The line was in compression at this point, probably due to temperature conditions. Therefore, a 1-inch piece of pipe was removed from the downstream section, leaving a 1-inch gap. A level was taken but showed no noticeable vertical separation. The work was left overnight and, due to contraction caused by cooling and atmospheric temperature, the gap was widened to 2½ inches. Repairs consisted of placing one welding sleeve (dimensioned as on the first repair) around the gap and welding it in place. The line was returned to normal service with the parallel main on July 4, 1953.

Since the pipe line was put back into operation, study of this particular section has been continued. There has been no apparent movement of the main and the repairs have proven to be completely satisfactory. Three openings were left in the backfill as reference points where occasional levels may be secured. Permanent markers, consisting of wooden posts, have been placed along the fault line to ascertain any movement that may take place in the future. Since the stress relieving was completed, no such movement has been noted.

It is extremely fortunate that the fault broke up into smaller ground movements southeast of the pipe line. Had this not been the case and the full shock of the fault movement perpetrated upon one point, it is impossible to say what might have happened. Perhaps the main would have ruptured; perhaps it would have pulled free through the comparatively-new backfill—it can only be left to speculation.

Lowering the operating line pressure materially reduced the strain on the pipe, and prompt action in removing the overburden and blocking the main as it lifted kept shearing to a minimum. Fortune, only, kept landslides and rolling boulders from striking the open spans and rupturing these vulnerable locations.

That no greater damage was done can only be ascribed to the nature of the earthquake and to the shock-resistant construction of the pipe line.

However, there is still the possibility of an earthquake of a severity or type that could cause a rupture of the line, and certain special procedures are kept in readiness. At vital locations along the line is stored emergency bypass equipment, fabricated in such a way that it may be installed in the matter of a few hours. This equipment, consisting of 34-inch welding caps, pipe nipples and 12-inch side outlets, complete with flanges, would act as the terminal points of an emergency bypass line until permanent repairs could be completed.

Reactivation of the White Wolf fault has awakened pipe line men everywhere to the everpresent threat of man's best friend—or worst enemy—nature. **—The End**

Communications

Continued from Page 53

reliability and lower maintenance costs.

Experimental transistors now sell anywhere from $7 to $20 each, but already the possibility of rolling them out of automatic machinery at costs anywhere from $1 to 25 cents each can be seen. This means that ultimately they will be found in broadcast receivers and television sets; not because they will perform any better than vacuum tubes, but because they will be cheaper.

Mass production of transistors for use in consumer equipment is some years away, and some of the first applications of the transistors will be in the telephone and the two-way radio communications industries. In the telephone industry, it has been suggested that the use of transistors in a new microphone design to provide substantially higher voltage output will enable the future distribution of messages within a city over substantially smaller gauge wire, with the result that in any given city millions of tons of copper will be saved in accomplishing the distribution.

Application in paging equipment, power line carrier devices, protective relaying, telemetering, and in remote control devices, will be a natural development in the transistor field. The application of the transistor to wire and radio communications, and to military and industrial commercial electronic devices, is so promising that changes may be expected in the design of equipment over the next ten years which may be characterized as revolutionary. Another form of transistor, made of silicon rather than germanium, promises satisfactory operation at temperatures substantially higher than possible with germanium. Small rectifiers, made with germanium or silicon, may offer wide application of D.C. motors from A.C. sources in railroad, traction, and industrial applications.

The use of the transistor is one small example of engineering application derived from the advances of science in the solid state field. This is only the beginning. The advances to be made in the next 25 years will far overreach anything seen in the past 25 years. The age of science is just beginning.

ACKNOWLEDGMENT

From a talk presented before the Petroleum Industry Electrical Association April 6 in Dallas.

—The End

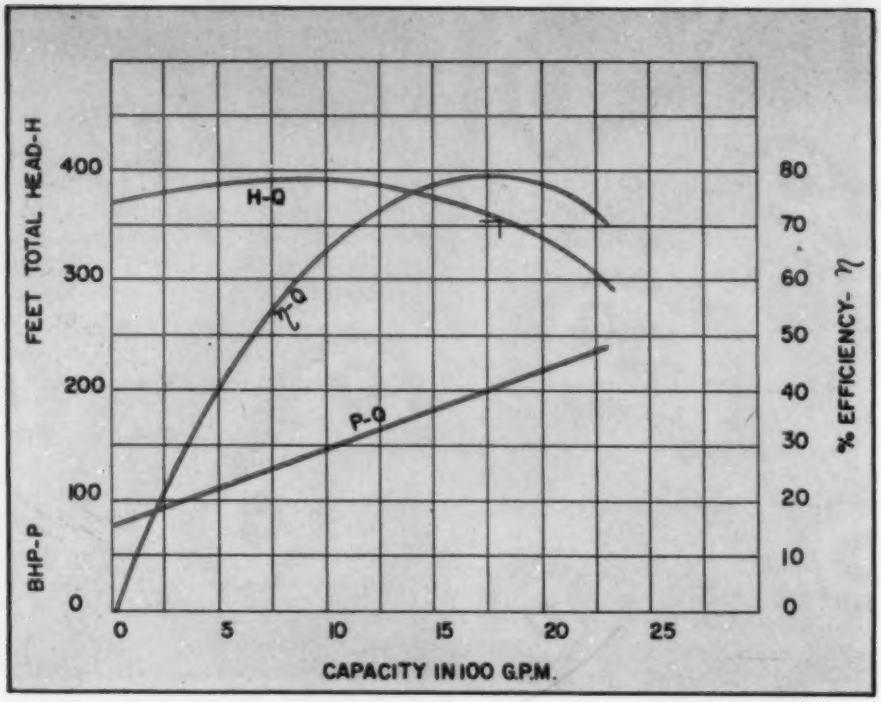

Fig. 1.—Characteristics of a double suction pump of a Ns = 908 type operating at 1760 RPM. A single suction pump of Ns = 643 would have a similar characteristic.

Centrifugal Pump Relations And Characteristic Curves

The centrifugal pump must be understood completely to be applied correctly. This article gives the reader a basic understanding of variables involved.

By ROY CARTER and IGOR J. KARASSIK, Worthington Corporation

WHEN A CENTRIFUGAL pump is operated at constant speed, it can deliver any capacity from zero to some maximum value depending on the size and design of the pump and prevailing suction conditions. The total head developed by a pump, the power required to drive it, and the resulting efficiency vary with pump capacity. The relations between these four variables are commonly known as the "characteristics of the pump" and are generally presented graphically in the form of "characteristic curves." As shown on Figures 1, 2, 3 and 4 it is the practice to plot the head, power and efficiency against pump capacity at a constant speed.

Pump characteristics. The curve H-Q, showing the relation between total head and capacity is called the head-capacity curve. The curve P-Q, showing the relation between power input and capacity is the power-capacity curve, generally referred to as the power curve, brake horsepower curve or bhp curve. The curve n-Q, showing the relation between efficiency and capacity is the efficiency-capacity curve, but is generally referred to as simply the efficiency curve.

A fifth component, the pump speed, may be involved if the pump is intended to operate at variable speed. Also, whenever suction conditions may be critical, characteristic curves may also show the required "net positive suction head" (NPSH) or the maximum permissible suction lift.

Other constants and relations. In addition to these characteristics, centrifugal pump designers use various other constants and relations in analyzing experimental data. Only one of these, specific speed, is of real importance to users of centrifugal pumps. Before discussing this, it should be pointed out that it is the general practice to compare pumps and analyze their performance at their so-called "design conditions." These correspond to that head and capacity condition at rated speed, at which the pump attains its maximum efficiency.

Specific speed. The basic definition of specific speed is that it is the speed in revolutions per minute at which a theoretical and geometrically similar pump would run if it were proportioned to deliver 1 gallon per minute against 1 foot total head, at its best efficiency point. It is important, however, to realize that the specific speed is an index or a type number using the capacity and head obtained at the best efficiency rather than the rotative speed of a 1 gpm, 1 foot total head model of the pump, because such a model pump—if made—would be too small to give comparable hydraulic results.

The formula for determining specific speed is:

$$N_s = \frac{n\sqrt{Q}}{H^{3/4}}$$

where N_s = specific speed
n = Rotative speed in RPM
Q = GPM capacity at n RPM and Head H
H = Total head per stage, in feet

The normal range of specific speed encountered in single suction impeller designs is from 500 to 15,000 with approximate impeller profiles as shown in Figure 5. Basically, the lower the specific speed, the higher the head that can be developed per stage by the pump (Figure 6).

It is sometimes desirable to determine the specific speed of a pump at capacities and heads other than at the best efficiency point (Figure 2) but such specific speed values must

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not be taken as an index of the pump type.

A very important application of the specific speed concept is the effect of the latter on the permissible and recommended suction conditions. The Specific Speed Limit Charts of the Hydraulic Institute showing their recommendations are reproduced in modified form in Figure 6.

Classification of H-Q curve shapes. Pump head-capacity curves are often classified by their shapes. Terminology in common use is:

1. Rising characteristic—meaning a curve in which the head rises continuously as the capacity is decreased. (See Figures 2, 3 and 4.)

2. Drooping characteristic—covering cases in which the head-capacity developed at shutoff is less than that developed at some capacities. (This is also known as a looping curve. See Figure 1.)

3. Steep characteristic—in which there is a large increase in head between that developed at design capacity and that developed at shutoff. It is sometimes applied to a limited portion of the curve; for example, a pump may be said to have a steep characteristic between 50 percent and 100 percent of the design capacity. (See Figures 3 and 4.)

4. Flat characteristic—referring to a head-capacity characteristic in which the head varies slightly with capacity from shutoff to design capacity. The characteristic might be in addition, either drooping or rising. (See Figure 1.)

5. Stable characteristic—referring to a head-capacity characteristic in which only one capacity can be obtained at any one head. Basically this has to be a rising characteristic. (See Figures 2, 3 and 4.)

6. Unstable characteristic—referring to a head-capacity characteristic in which the same head is developed at two or more capacities. (See Figure 1.)

Classification of P-Q curve shapes. Figure 2 illustrates a pump characteristic with a power (P-Q) curve (bhp on graph) which flattens out and then decreases as the capacity increases beyond the maximum efficiency point. This is called a non-overloading curve. When the power (P-Q) curve continues to increase with an increase in capacity, as with the characteristic shown in Figure 1 as the bhp curve, the pump is said to have an overloading curve.

Fig. 2 (right)—Characteristics of a double suction pump of a Ns = 1740 type operating at 1760 RPM with auxiliary specific speed curve showing how specific speed at other than design conditions varies from 0 to infinity. Equivalent single suction type would be Ns = 1230.

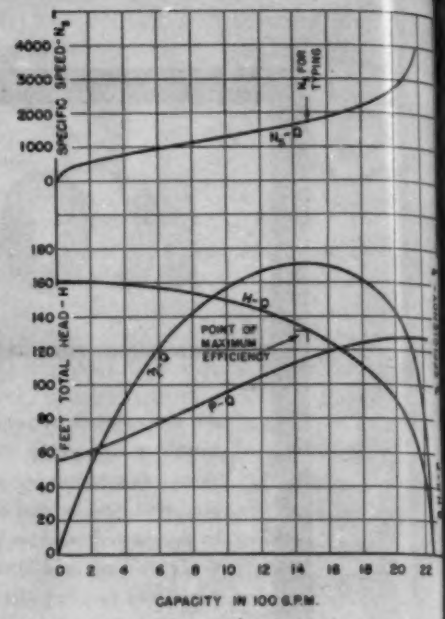


Fig. 3 (below left)—Characteristics of a single suction mixed flow Ns = 5200 type pump operating at 400 RPM.

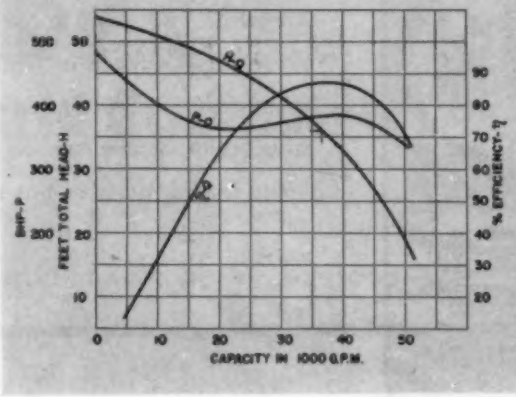
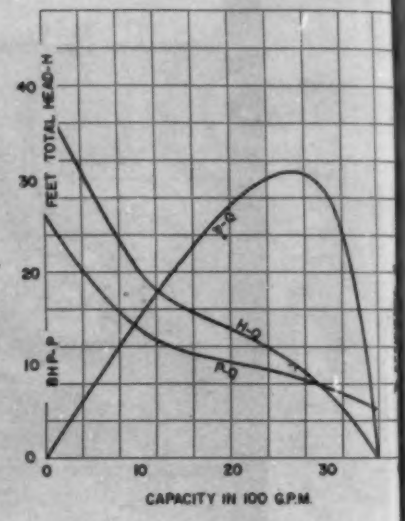


Fig 4 (below right)—Characteristics of a single suction axial flow pump of Ns = 10,600 type operating at 1150 RPM.



While in Figure 1 the P-Q or bhp curve is of the overloading type with a decrease in head and increase in capacity, the P-Q or bhp curve shown in Figure 4 is of the overloading type with an increase in head and decrease in capacity.

The shape of the power curves (P-Q or bhp) varies with the specific speed type. As a result the power curve may be one which has a very low value at shutoff, as illustrated in Figures 1 and 2, or it may be one which has a high shutoff power as illustrated in Figure 4, or anything between these types.

While pumps with non-overloading power curves are advantageous because the driver is not overloaded under any operating conditions, they are not obtainable in all specific speed types of pumps. The actual range in operating conditions to be encountered in the operation of a pump determines the range in power requirements, and the driver size should be selected for the power demand to be encountered.

Mathematical relations of head, capacity, efficiency and bhp. The useful work done by a pump is the weight of liquid pumped in a period of time multiplied by the head developed by the pump. This is generally expressed in terms of horsepower and

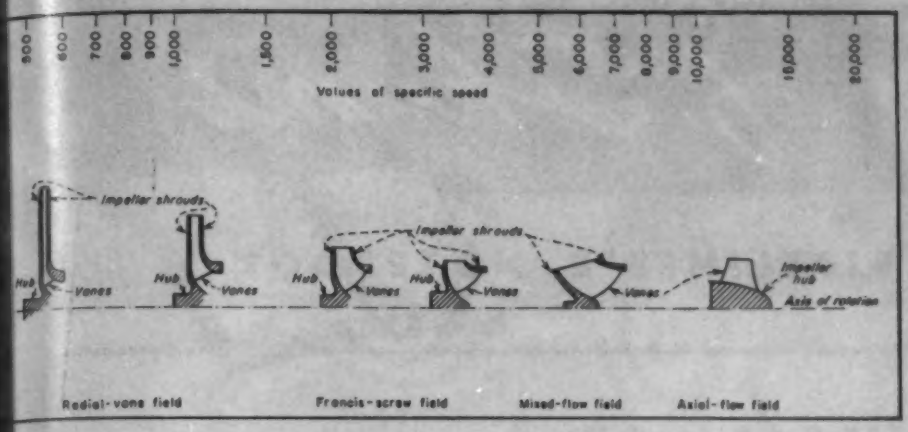


Fig. 5 (above)—Variation in profile of single suction impellers with specific speed type.

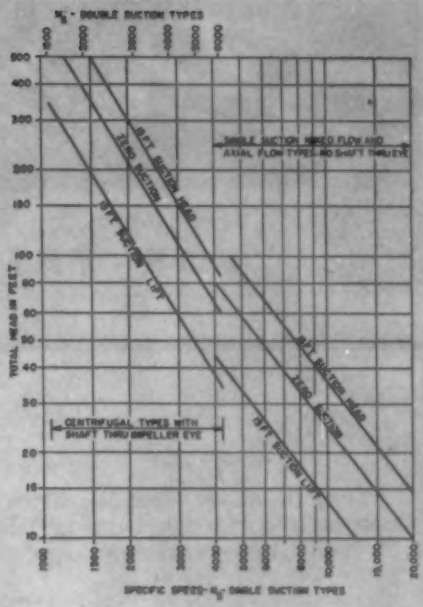

DOUBLE SUCTION TYPES
SINGLE SUCTION MIXED FLOW AND AXIAL FLOW TYPES—NO SHAFT THRU EYE
SINGLE SUCTION MIXED FLOW
SINGLE SUCTION AXIAL FLOW
SPLIT SUCTION CURVE
CENTRIFUGAL TYPES WITH SHAFT THRU IMPELLER EYE
TOTAL HEAD IN FEET
SPECIFIC SPEED-DOUBLE SUCTION TYPES

Fig. 6 (right)—Composite Hydraulic Institute Specific Speed Limit Charts for three suction conditions.

is called "water horsepower." It can be determined by the relation,

$$\text{WHP} = Q \times H \times \frac{\text{specific gravity}}{3960}$$

where Q = pump capacity in gpm
where H = total head in feet.

The power required to drive the pump is regularly determined in horsepower and is called the bhp input to the pump. The ratio of the whp output to the bhp input is the pump efficiency. The relation between bhp, capacity, head and efficiency is therefore:

$$\text{bhp} = \frac{Q \times H}{\text{efficiency}} \times \frac{\text{specific gravity}}{3960}$$

Centrifugal pump comparison relations. There are certain relations whereby the performance of a centrifugal pump can be predicted for another speed than that at which the pump characteristic is known. There are also certain relations whereby we can predict the performance of a pump if the impeller were to be cut down in diameter (within a limit depending upon the impeller design) from the characteristics obtained at the larger diameter. When the speed is changed:

1. The capacity for a given point on the pump characteristics varies as the speed, while at the same time
2. The head varies as the square of the speed, and
3. The bhp varies as the cube of the speed.

Putting these relations in the form of equations, we have

$$Q = Q_1 \times (n/n_1)$$
$$H = H_1 \times (n/n_1)^2$$
$$P = P_1 \times (n/n_1)^3$$

$$\text{or } \frac{n}{n_1} = \frac{Q}{Q_1} = \sqrt{\frac{H}{H_1}} = \sqrt[3]{\frac{P}{P_1}}$$

where
n = new speed desired in rpm
Q = capacity in gpm at desired speed n
H = head in feet at desired speed n for capacity Q
P = bhp at desired speed n at H and Q
n_1 = speed in rpm at which the characteristics are known
Q_1 = capacity at speed n_1
H_1 = head at capacity Q_1 at speed n_1
P_1 = bhp at speed n_1 at H_1 and Q_1

These relations can be used with safety for moderate changes in speed. They may not be found accurate in case of a large change in speed, especially when that is an increase.

It is possible to reduce the diameter of the impeller by actually cutting it down in a lathe. The average impeller can be cut down to about 20 percent of its original maximum diameter without adverse effect. Cutting it down to less than 80 percent of original diameter will generally result in a much lower efficiency.

This limit of 20 percent is of course merely approximate as some designs of impellers can be cut more than this, while others cannot be cut more than a small percentage without adverse effect. Actually any change in diameter will affect the proportions of the impeller and some variations from the theoretical results should be expected when tested.

If an impeller of a suitable design is cut in diameter, the characteristics of the pump at one speed will have a definite relation to its original characteristics, or closely so. These relations are:

1. The capacity for a given point in the pump characteristic varies as the impeller diameter, while at the same time
2. The head varies at the square of the impeller diameter, and
3. The horsepower varies as the cube of the impeller diameter.

Expressed in form of equations, these are:

$$Q = Q_1 \times (D/D_1)$$
$$H = H_1 \times (D/D_1)^2$$
$$P = P_1 \times (D/D_1)^3$$

$$\frac{D}{D_1} = \frac{Q}{Q_1} = \sqrt{\frac{H}{H_1}} = \sqrt[3]{\frac{P}{P_1}}$$

D_1 = original diameter (inches)
D = cut down diameter (inches)
Q_1 = capacity with D″$_1$ impeller
Q = corresponding capacity with D″ impeller
H_1 = head with D″ impeller at capacity Q_1
H = corresponding head with D″ impeller at capacity Q
P_1 = bhp with D″$_1$ impeller at capacity Q_1 and head H_1
P = bhp with D″ impeller at capacity Q and head H

The most common problems utilizing these relations are to determine the change in speed, the change in impeller diameter, or a combination of both necessary to produce a head-capacity characteristic passing through a chosen point. —**The End**

Rules of Thumb

FOR THE PIPELINER'S NOTEBOOK

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Miscellaneous —14—How to determine the number of gallons in a vertical cylindrical tank.

RULE: Multiply the diameter of the tank, in feet, times one-half the height in inches to find the number of gallons in a tank.

Example: How many gallons will a tank 12 feet in diameter and 16 feet high hold when full?

$$\text{Gallons} = D^2 \times \tfrac{1}{2} h$$

$D = 12$ ft.

$h = 96$ inches

$$\text{Gallons} = 12 \times 12 \times 96 = 13{,}824 \text{ gal.}$$

Miscellaneous —15—How to determine head loss due to friction in ordinary iron pipe line carrying clear water.

The form given below gives a reasonable degree of accuracy.

$$S = \frac{G^2}{10\,d^5}$$

where:

S is the head loss due to friction in feet per 100 feet length of pipe line

G is the rate of flow in gallons per minute

d is the nominal diameter of pipe in inches

The exact head loss due to friction in pipe lines carrying clear water is given by the Williams and Hazen formula

$$S = \left[\frac{V}{1.318\,C\,R^{.63}}\right]1.85$$

where S = loss of head due to friction in feet per hundred feet

V = average velocity in feet per second

C = coefficient depending on the roughness of inside the pipe

R = the mean hydraulic radius $= \frac{D}{4}$ where D is the diameter in feet.

The average velocity V is given by $\frac{Q}{a}$ where Q is the rate of flow in ft.^{3}/sec. a is the cross sectional area of the pipe.

C is a function of the material and age of the pipe and the type of water. For smooth new iron pipe C = 120. For 15-year-old ordinary pipe C = 100. For 25-year-old ordinary pipe C = 90.

Problem: What will be the head loss per 100 feet if a ten-inch line flows 100 gpm?

$$\text{Solution: } S = \frac{10^6}{10 \times 10^5} = 1.0 \text{ ft.}$$

Exact answer using the Williams and Hazen formula

C = 100

S = 1.01 ft.

Problem: What will be the head loss per 100 feet if a 30-inch line flows 10,000 gpm?

Solution:

$$S = \frac{(10{,}000)^2}{10\,(30)^5} = \frac{100}{243} = .41 \text{ ft.}$$

Exact answer using the Williams and Hazen formula

S = .34 ft.

Remarks:

This rule of thumb could be very satisfactorily used for pipe diameters three inches and larger and a discharge greater than 400 gpm.

This rule applies only to wrought and cast iron pipes (20 years service). If new smooth brass or steel pipe is used, a factor should be used = .6.

For new smooth iron pipe, factor = . +

For 30-year-old ordinary pipe factor = 1.2. These are empirical factors.

For pipe diameters two inches and less and discharges less than 200 gpm, this rule of thumb does not give satisfactory results.

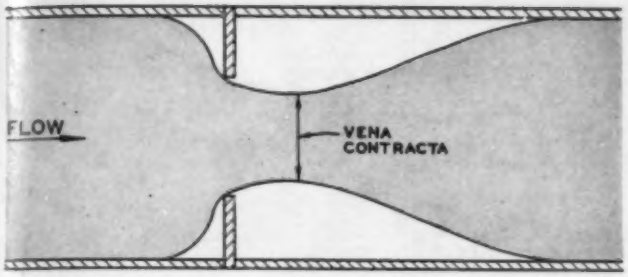

Figure 1. Normal flow: Sharp, square edge orifice plate.

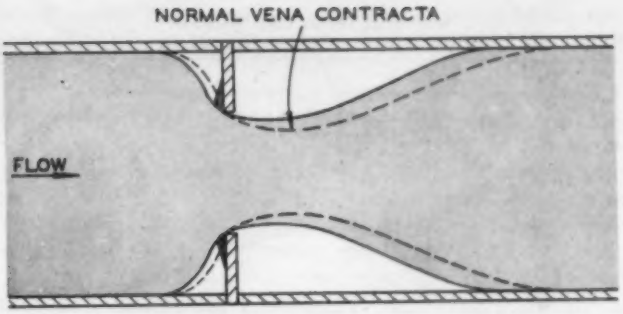

Figure 2. Erroneous flow: Orifice having rounded up-stream edge.

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THE "ORIFICE METER" is not just the differential pressure gage as many so often think of it. The orifice meter is a combination of the orifice plate, meter run, gage lines, differential gage, and static pressure element. The combination of all of these component parts forms the orifice meter and enables us to measure a flowing gas.

To avoid the necessity of calibrating orifice plates individually in the meter run in which they are to be used, definite specifications have been set up by the American Gas Association on the orifice plate and meter run to permit duplication of the basic elements from which the orifice coefficients were originally determined. For this reason, strict adherence to those specifications is necessary if accurate measurement is to be obtained. Probably the most important requirement for the orifice plate is that the upstream edge be square and sharp so as not to appreciably reflect a beam of light. Various other specifications, such as flatness, edge width, etc., should also be followed because deviation from established specifications might result in an accumulation of additive errors. Since an accurate record of differential pressure and static pressure is requisite for good gas measurement, presume for the moment that the meter run and orifice plate were constructed according to established specifications at the time of initial installation, and give concern only to those deviations from ideal flowing conditions which might result from continued use and cause error in the measurement.

The upstream edge of the orifice might become rounded because of abrasive material in the flowing fluid. A rounding of the orifice edge would result in a low differential reading with consequent low measurement. The diameter of the stream at the "vena-contracta"—the point of minimum cross-section of the stream, downstream of the orifice —largely determines the coefficient of the orifice (Figures 1 and 2). Anything that would tend to increase the diameter of the stream at this point of greatest contraction would increase the discharge through the orifice for a given differential pressure; in other words, it would cause the coefficient to increase. An accumulation of dirt on the upstream face of the orifice might be the equivalent of a rounded upstream edge, since it would tend to streamline the gas approaching the orifice (Figure 3).

An accumulation of dirt in the meter run ahead of the orifice plate could cause either low measurement or high measurement, depending upon the amount of the build-up. If the build-up did not obstruct the orifice opening, its effect would be a streamlining of the flow lines with consequent decrease of differential pressure and resulting low measurement (Figure 4). If the build-up were sufficient partly to obstruct the orifice opening, the differential pressure reading would increase and consequently the measurement would be high (Figure 5).

Any change in the inside surface finish of the meter run might cause a distortion of flow from that corresponding to the conditions for which the coefficients were originally determined and consequently cause an error in measurement. The effect of roughening the inside surface beyond that corresponding to standard selected pipe usually causes a decrease in differential pressure and low measurement. Correspondingly, the use of a smoother inside surface than that which existed inside the meter runs on which the basic data were obtained would introduce an error in the measurement. Variation of the surface finish would result in a consequent variation of the velocity pattern over the cross-section of the pipe in the section upstream of the orifice. For example, a rough inside surface would slow down the velocity of the stream adjacent to the pipe wall; consequently, for a given rate of flow, the center velocity would have to be higher than normal. This higher than normal center velocity would produce a "jet effect" which

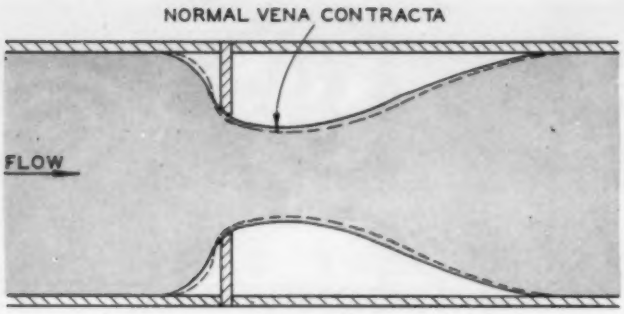


Figure 3. Erroneous flow: Accumulation of dirt on up-stream face of orifice.

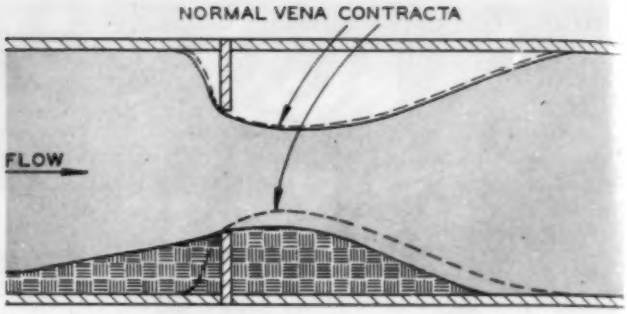


Figure 4. Erroneous flow: Dirt, liquid or foreign material accumulating ahead of orifice.

would distort the vena-contracta with consequent increase in the coefficient of discharge (Figure 6).

Consistently accurate measurement under conditions where the flowing medium contains suspended solids, such as hydrates, offers a real challenge to measurement men (Figure 7). For example, hydrates may start to build up gradually on the upstream surface of the plate, possibly rounding the upstream edge. The result of this initial build-up usually constitutes a streamlining of the channel with a resulting increase of the coefficient. This prevents the plate from producing the correct differential pressure for a given flow, and causes a low reading.

This initial build-up and consequent streamlining of the upstream edge can progress to a point where the build-up can become great enough to start closing in the orifice opening. When the build-up reaches this condition, the orifice plate opening, being actually smaller than it was originally, creates more differential pressure than it should for a given flow condition and the meter reading is too high.

More Troubles—To add further to the meterman's troubles, these foregoing conditions which caused erroneous measurement can suddenly return to proper flow pattern. A sudden change in flow rate, pressure or temperature fluctuations in the line, etc., have been known to dislodge the suspended matter from the orifice plate opening and return the flowing stream to approximately proper conditions. Under these unstable circumstances, it is impossible to obtain accurate measurement. The only solution is to eliminate the hydrates by the addition of heat, the injection of alcohol, or some other suitable agent.

The measurement of wet gas with an orifice meter is extremely difficult, since to obtain accurate measurement it is necessary to know the *actual* density of the flowing fluid as it passes through the orifice (Figure 8). When wet gas is being measured, the liquid is mechanically entrained in the gas stream as minute droplets in the form of a mist. The relatively heavy liquid droplets would create an *actual* density much higher than that which would be measured by a conventional gravitometer. In sampling such a flowing stream, there would be a tendency for the liquid to drop out, since this liquid is held in a state of mechanical suspension because of the velocity of the stream. Sometimes average correction for an over-all time period can be made when the ratio of the liquid to gas can be definitely determined and an average density correction made.

The problem is also complicated by the possibility of liquid condensing out in the mercury manometer chambers. These difficulties can be reduced somewhat by the use of bellows type differential gages with pressure connections made at the bottom of the manometer. With proper piping, this arrangement can be made to be more or less self-draining and do much to prevent the error caused by formation of liquid in the chambers of the conventional mercury manometer.

Periodic inspection of the meter run and orifice plate will insure against any deviations from proper conditions of measurement. The type of measurement and the flowing condition will dictate how frequent such inspection should be. With new lines, where there is a possibility of hydrates, dust, etc., more frequent examination would be required than with an installation where the flowing fluid is relatively clean and stable.

Next, consider the differential gage which measures the pressure drop created by fluid flowing through the orifice. We will assume that the gage lines are tight and that all valves are in good repair, capable of a positive shut-off, and with no leakage at the valve stems. An examination of the manometer will indicate that the reading is a direct function of the difference in levels in the manometer chambers and the consequent rise of the float in one of the chambers.

A comparison of the manometer reading with a suitable water column will indicate not only whether the calibration of the differential gage is correct, but will also serve as an indication as to flaws in the mechanism—such as might result from stuffing box binds, dirty mercury, or from an incrustation on the manometer walls. The water gage is attached to the high side of the manometer and a comparison of readings can be made by a manipulation of the valves in the gage lines.

It can be seen that the calibration is a direct function of the relative cross-sectional areas of the high and low sides of the manometer. The specific gravity of mercury is constant; and since there has been no change in the diameter of the manometer chambers, no change in the length of the float lever should be required to obtain proper calibration. No change in calibration should result from normal service. If the original calibration was accurate, the calibration should remain so. Any apparent change in calibration should be investigated as the possible result of friction, incrustation on the manometer walls, or from foreign material in the manometer chambers. The check valves should be cleaned and adjusted so that they will operate freely. New seat discs should be installed where soft-seated check valves are used. The effect of wear can usually be disregarded in conventional orifice meters, since no motion occurs except when there is a change in flow. Proper calibration requires that the pen arm be of the proper length. Adjustment of the pen arm length so that proper arcing is obtained is a necessity for good calibration and measurement. After the manometer has been cleaned and all maintenance operations have been completed, the manometer should be leveled and the correct amount of clean mercury placed in the manometer.

A recalibration check with a water gage is then made to confirm the accuracy of the device after cleaning and

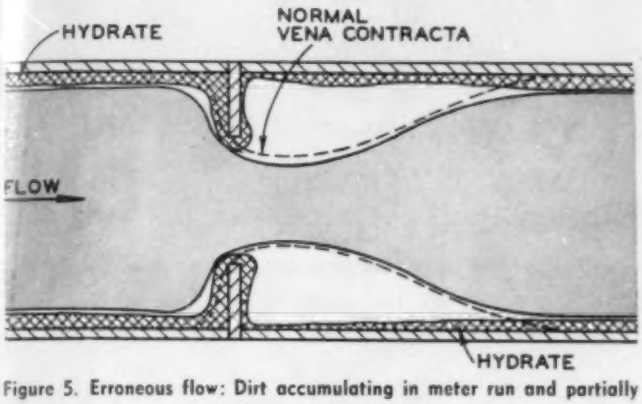


Figure 5. Erroneous flow: Dirt accumulating in meter run and partially obstructing orifice.

maintenance operations. When the manometer is calibrated and properly adjusted, the readings will check a water column perfectly throughout the range of the instrument. A check test beyond the range of the meter will indicate whether the meter is capable of motion slightly beyond full range, thus insuring good measurement up to the one hundred percent scale position. The meter should then be zeroed under pressure. Care should be exercised in manipulating the gage line valves while putting the meter into service or taking it out of service.

The bourdon static pressure element used in gas measurement is as important to the flow calculation as is the manometer. Consequently, too much emphasis cannot be given to the care and calibration which this device should receive. Field calibrations are usually made with either an accurate test gage or with a dead weight tester. Shop calibrations are usually made with a dead weight tester, since it is fundamentally a more accurate reference. When using the dead weight tester, the connections should be arranged so that oil from the tester does not enter the capillary tubing or the helical elements, thereby creating possible obstructions and consequent false readings.

Factors Governing Accuracy—Other factors which influence the accuracy of orifice meters are as follows:

Improper notation on the chart can be a source of very serious error. For example, if a plate has recently been changed on a given application and the chart changer fails to note this change in plate size on the chart, as well as the corresponding change in coefficient, it could lead not only to error but to a great deal of difficulty by the person figuring the chart. As a result, extreme care should be taken to note all the required information as accurately as possible.

Small pits on the upstream face of the orifice plate

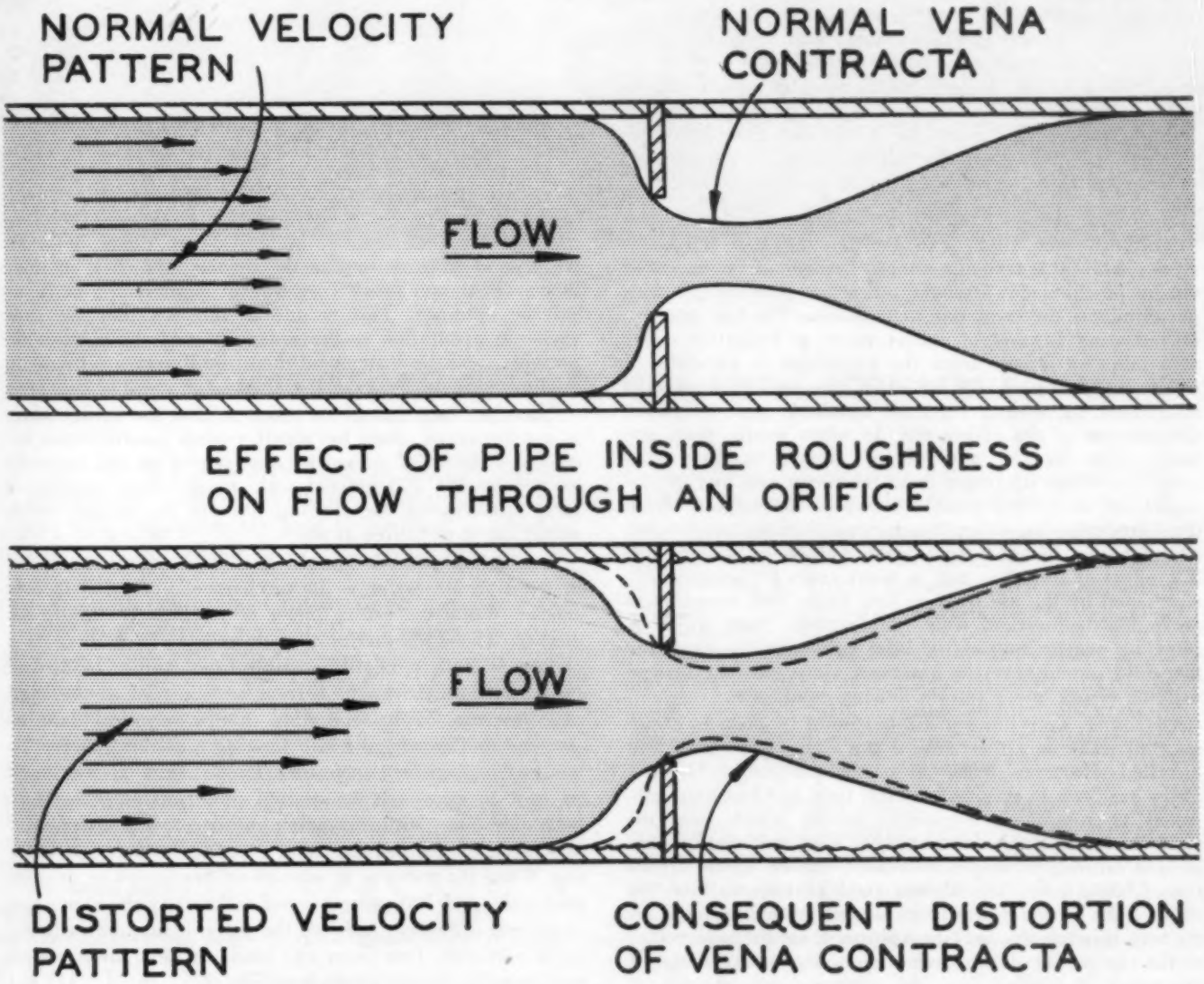


Figure 6. Erroneous flow: Pipe inside roughness.

probably do not make as much error in measurement as is sometimes thought. This is not to be interpreted as a plea, however, for using orifice plates with pitted surfaces since a smooth plate has a more presentable appearance, and measurement with a smooth plate is generally more acceptable. Pits may eventually lead to trouble, particularly if the pits are anywhere near the orifice edge of the plate on the upstream side. They might also permit dust and dirt to cling to the upstream surface of the plate, thereby causing errors in the measurement.

While small nicks on the upstream edge are not to be condoned, these errors are not usually so serious nor of so great a magnitude as those which are brought about when the entire circumference of the hole has a very slight radius on the upstream edge. To be more specific, anything which distorts the entire circumference of the hole in the orifice plate can produce a much greater error than a small nick at one point on the circumference.

Close inspection should be given to the taps—whether flange or pipe taps are used—to see that no burrs protrude into the line, as these obviously can produce eddy currents which may distort the differential pressure and cause error in either a plus or minus direction.

All conventional orifice meters can be furnished with a pulsation dampener or choke. Extreme care should be taken to safeguard against damping the meter too much. In calibrating the meter, one can readily ascertain whether or not the meter has been overly damped by the response to a given differential imposed on the meter as compared to the water column or other reference to which the meter would be connected. Most persons like to see a meter respond to a small change—let us say 10 percent linear change in differential pressure—in a matter of a few seconds. However, a meter can be damped more than this and still be accurate if the changes in flow rate are not too sudden.

Best Pulsating Practice—Pulsating flow is one of the conditions which might lead one to damp a meter excessively. While it is true that a meter record can be smoothed out by pinching down on the pulsation dampener, it does not eliminate the error due to pulsation. The best practice on pulsating flows is, of course, to try to locate the meter at a point as remote from the pulsations as possible. If this is not possible, the effect of the pulsation may be minimized by adding capacity upstream and resistance downstream of the orifice run. In other words, there are times when by the addition of greater capacity—i.e., larger pipe size upstream from the meter run and the insertion of an orifice plate somewhere downstream from the meter run—pulsations can be smoothed out very nicely, although this is not a fool-proof method by any means. The effect of pulsation can in many cases be substantially eliminated by the use of high beta ratios and manometers of higher-than-normal differential range. Such tricks as pinching one or both of the inlet valves on the gage line manifold should never be practiced, since they can lead to extreme errors under certain flowing conditions.

Of course, everything possible should be done to eliminate all leaks on either side of the meter when it is first installed. However, leaks do occur, particularly after a meter has been in service for some time and has been subjected to routine maintenance—during which time the gage lines on the meter may have been subjected to abnormal strains. If the measurement record seems higher than it should be, it is always good practice to look for slight leaks on the downstream side of the meter body, all the way through the gage line piping from the manometer to the tap on the downstream side of the orifice plate. If the meter is reading low, the upstream side should, of course, be correspondingly checked.

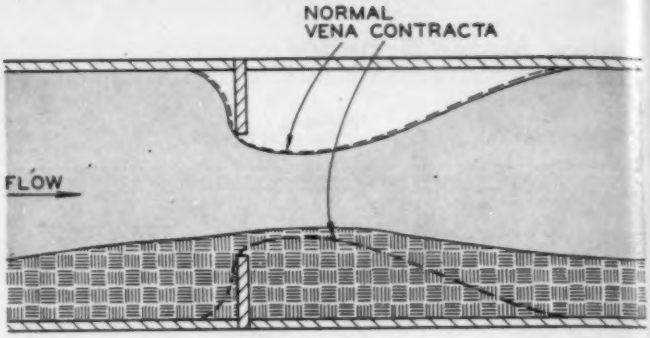


Figure 7. Indefinite flow: Hydrate formation inside meter run and on orifice.

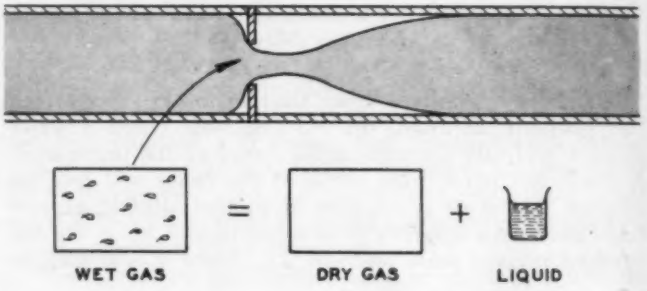


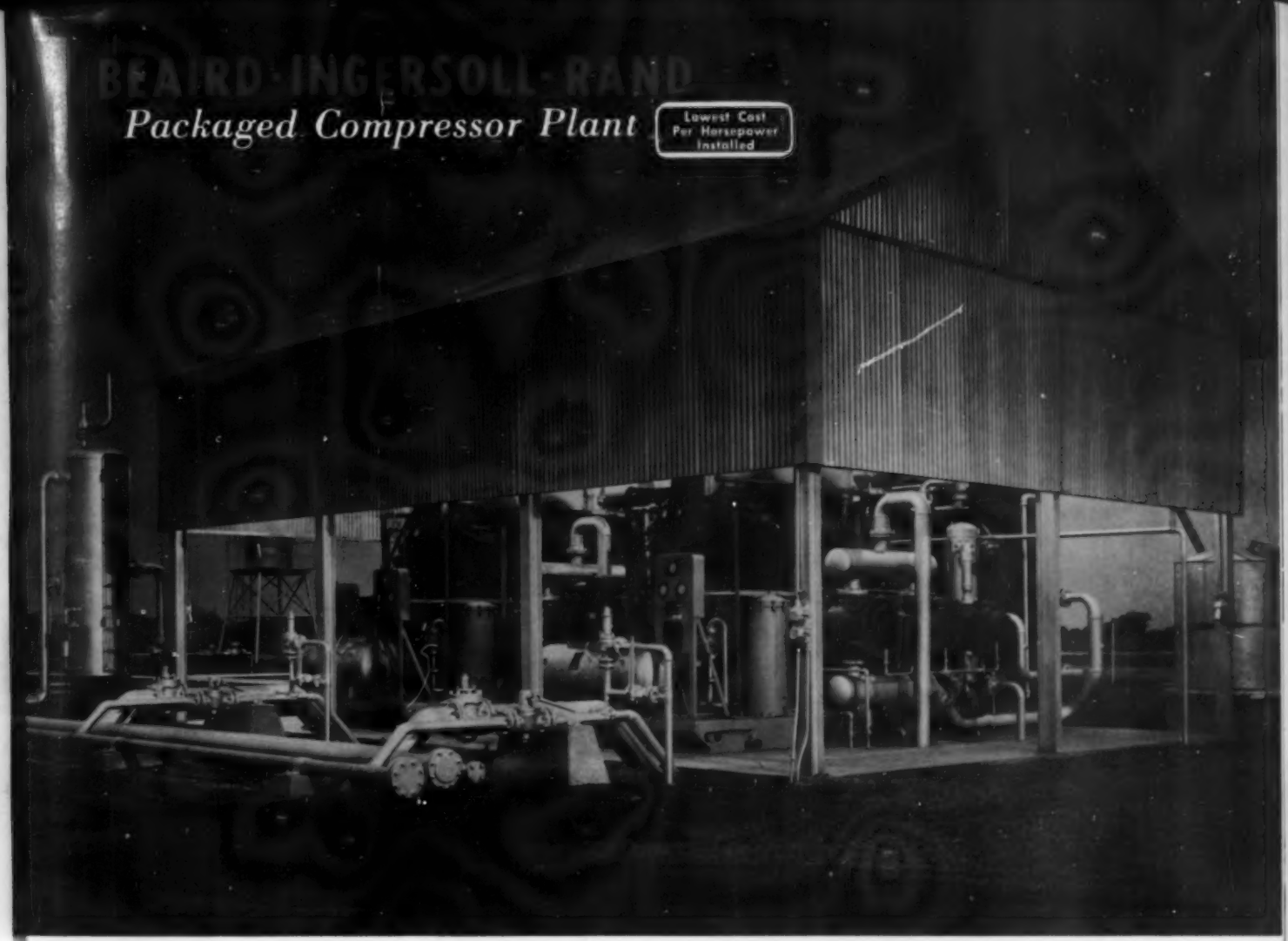
Figure 8. Density: Don't forget the entrained liquid.

Care should also be taken in sizing the orifice plate to keep the meter operating in a readable range. Since the orifice meter is fundamentally limited in rangeability, it is always good practice to size the orifice in such a way that at minimum normal flows the pen reading will usually be above the lower third of the total range. To state this somewhat differently, on a 100-inch meter, it is always good practice to size the orifice in such a manner that at minimum flows a reading of eight inches or more will be obtained. This is due to the fact that the flow varies in proportion to the square root of the differential pressure, and the instrument therefore becomes difficult to read at the lower limits of its range.

Likewise, care should be taken so that the orifice plate is not too small, since too small a plate would create excessive differential pressures, and can cause the meter to go beyond the 100 percent scale range—thus enabling a large quantity of the flowing fluid to be passed which would not be measured at all.

Everything possible should be done to keep the meter in good repair as far as its mechanical operation is concerned. While the orifice meter is a relatively simple device in which no motion occurs except when there is a change in flow, it is still possible to encounter binds and dead spots which can be serious with regard to the total measurement. Faulty operation in this form can best be detected and corrected while running a calibration test on the meter. As every meterman knows, it is always good practice to approach the desired point on the scale from both directions, with increasing and decreasing differential pressures, to see that the meter reproduces the exact reading. When the meter is in over-all calibration—i.e., at zero, mid-scale, and 100 percent—and will satisfy the above test at several different places on the scale, it may be assumed to be relatively free from any binds or dead spots which might tend to hinder good measurement.

—The End



This packaged compressor plant is complete with two Beaird-Ingersoll-Rand 6SVG, 330 h.p. gas engine driven compressors, Young radiators and all necessary equipment and controls. Other sizes from 110 h.p. to 660 h.p.

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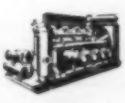
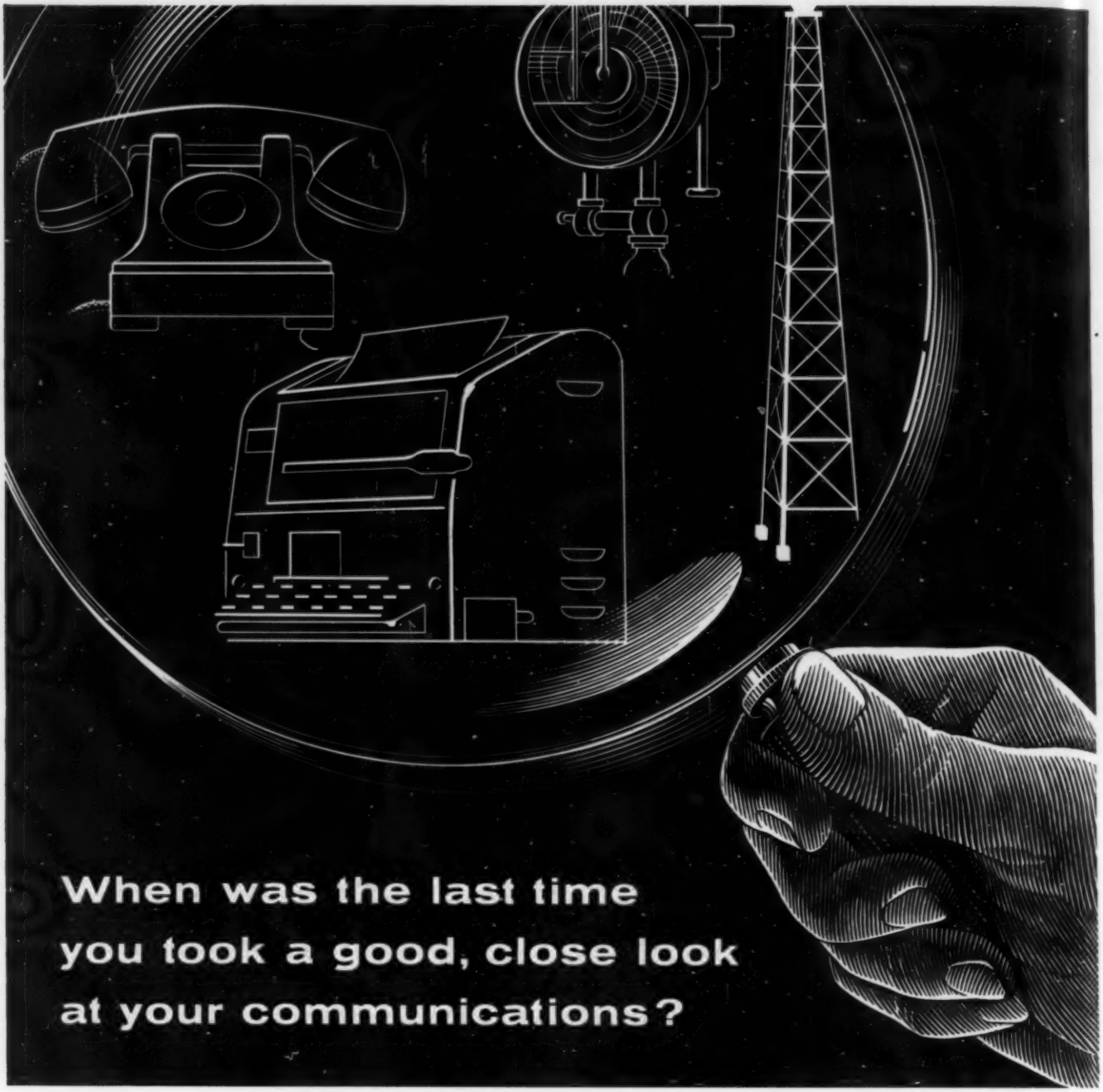

PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP-GAS SYSTEMS



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Cavern tunnels: Sized after visual observation of the limestone rock at the shaft bottom.

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Here's how one company solved the problem by . . .

Storing Propane in an Excavated Cavern

By J. W. NIXON, National Petro-Chemicals Corporation, Tuscola, Ill.

AT THE NATIONAL Petro-Chemicals Corporation's new plant near Tuscola, Ill., the storage of liquid propane, normally produced at the rate of 10,000 barrels per day, presented several problems. Conventional pressure vessel storage is extremely costly, averaging between $17 and $20 per barrel installed, as well as occupying much valuable space. The various types of underground storage were considered and it was concluded that best approach was the excavated cavern. If underground strata could be found which offered both structural strength and impermeable characteristics for such storage, the project would be a very attractive investment.

A mining consulting firm was engaged in the summer of 1952 to conduct extensive core drilling and sub-surface exploratory work leading to the development of such a cavern. Seven holes, 400 feet deep, from which full cores were taken, and five other shorter holes for local shaft exploration were drilled in the four acres allocated to the

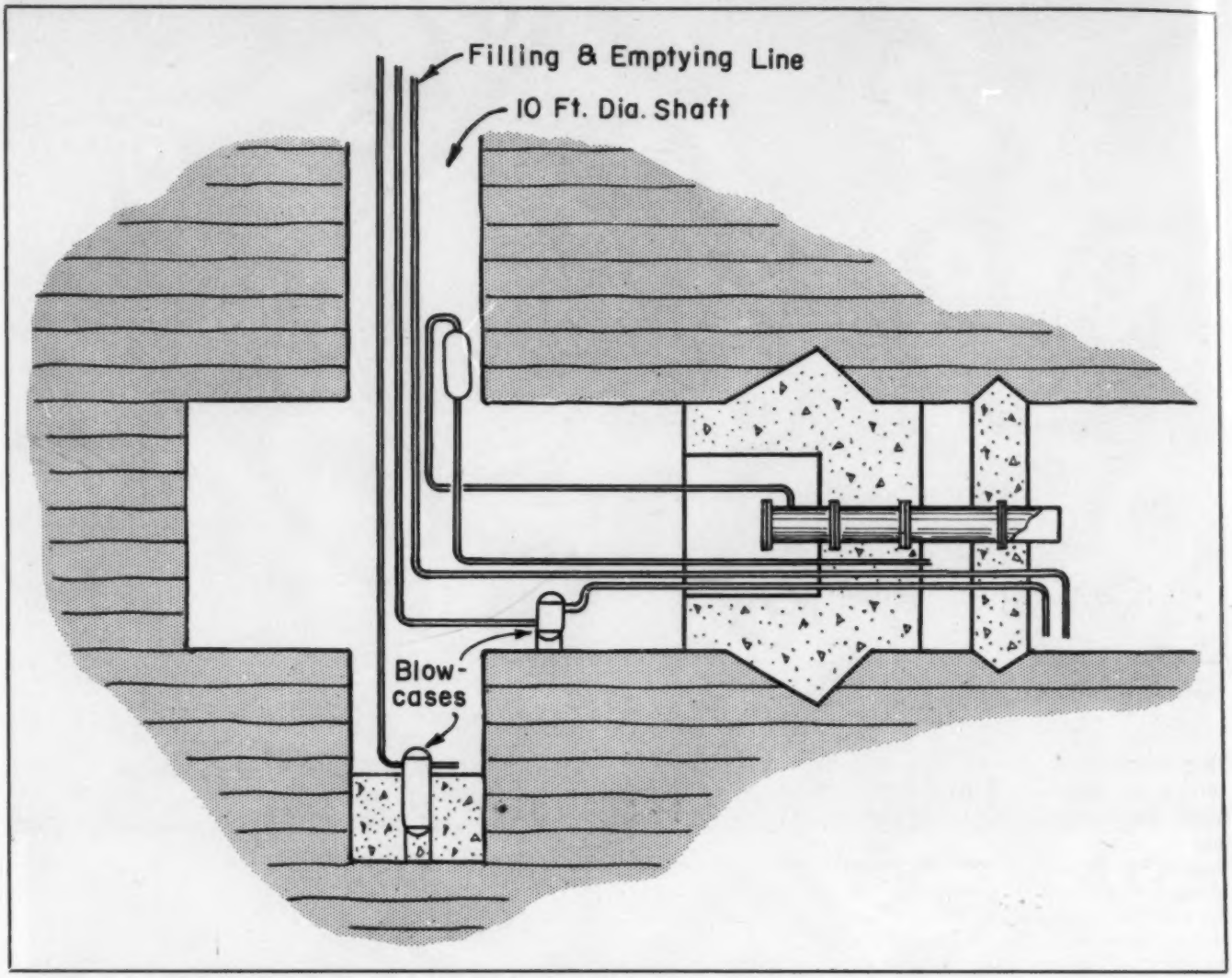


Figure 1. Vertical plug consisting of two bulkheads separated by three feet of alcohol-water mixture.

project. The results of this work indicated that the Millersville Limestone stratum at 327 feet offered the optimum level under which to construct the storage caverns. The limestone is extremely homogeneous, well consolidated, and tests of the cores indicated that it is impermeable to propane. It is eighteen feet thick and lies above a gray siltstone of good quality. Construction of the shaft and caverns ultimately confirmed all the exploratory geological work. It failed, however, in fully revealing a serious water sand problem at 78 feet as will be shown later. For those contemplating similar installations, extremely thorough and exhaustive subsurface coring and water sand determination is strongly recommended.

As is shown in Figure 2, the shaft is located in the southeast corner of a rectangular grid of five parallel tunnels each 450 feet long, connected at their northerly and southerly ends by 315-foot long drifts. The shaft was located as shown because the formation dipped to the southeast and the necessity of providing some means of extraction of seepage water in the rock was deemed advisable. The grade of the floor is such that if any water does accumulate it will drain toward the shaft where facilities are provided for its removal. The strike of the formation is approximately 18 degrees east of north; thus, further dictating the layout of the tunnels on a north-south centerline to simplify drainage. Although examination of the completed excavation has indicated that water will not be a problem in the storage vault, basic provisions for handling it must be made in the initial layout of any similar venture.

Following the geologic examination several methods of shaft sinking were considered. It was felt in the interest of expediting cavern mucking, a shaft large enough to accommodate a five-yard skip was justified. This requirement eliminated the use of large diameter boring tools, the maximum size of which was sixty inches. Of the two methods remaining—liner plate and caisson—it was felt the former would result in a less expensive and quicker operation and was therefore adopted using 12-foot liner plate lined with 1-foot thick concrete.

The contract was let to McLean-Grove & Company of New York in late November and field work began in early December, 1952. Progress was normal until the 78-foot level was reached. The anticipated water bearing sand suddenly broke loose flooding the shaft at the rate of 250 gpm. An air lock was installed and by working under 33 psig the stratum was sealed off after approximately three months' delay. The shaft was completed through 200 feet of overburden and 150 feet of mixed shale, coal, fire clay and limestone by November, 1953.

The cavern tunnels were sized after visual inspection of the limestone and siltstone rock at the shaft bottom.

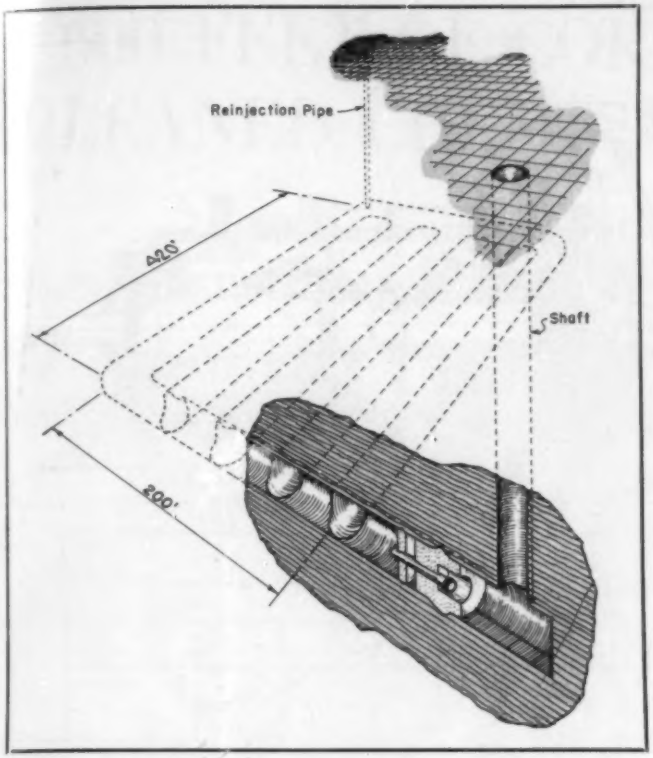


Figure 2. Shaft is located in the southeast corner of a rectangular grid of five parallel tunnels.

They resemble an inverted horseshoe in cross-section, the vertical dimension of which is nineteen feet and maximum horizontal dimension is 20 feet. The final excavated volume is about 173,000 barrels. Removal of the approximately 36,000 cubic yards of rock was done by drilling, blasting and mucking by means of an air-operated mucking machine equipped with belt loader and the use of two electric mine locomotives operated on 26-inch gauge rail. At the peak of operations, 60 loose cubic yards of rock per hour were extracted from the workings with the average from beginning to end about thirty yards per hour. Powder consumption for blasting averaged 4½ pounds per cubic yard.

The design of the bulkhead at the shaft end of the southern drift was originally based on the use of the available concrete sealing materials. Extensive experiments with concrete-filled 24-inch diameter steel pipes, one end of which was subjected to 100-psig air pressure, produced no suitable means of sealing against loss of air through the concrete. The present vertical plug now being installed will consist of two bulkheads separated by three feet of alcohol/water mixture as shown in Figure 1. This space will be maintained at a slightly higher pressure than exists in the cavern by means of the equalizing vessel located just above the cavern roof. Try lines will be extended from this vessel to ground level to determine any liquid loss and make-up liquid will be added through the vessel.

The simplified flow sheet (Figure 3) indicates the methods of propane filling and removal. Filling will be accomplished by pumping propane through the four-inch line extending down the shaft and through the bulkheads. Withdrawal of propane through the same line will be by exhausting vessel D-471 using rotary compressors C-401 A and B. These will discharge vapors through the six-inch re-injection casing which penetrates the roof of the cavern at a point most remote from the shaft. Propane will condense in the vessel D-471 from which it will be pumped to above-ground storage or to tank cars. Accumulated water in cavern or shaft bottom will be removed by means of individual blow cases.

Compared with conventional above-ground tankage, this project has in its favor a fraction of the surface area required, a minimum of maintenance, a high degree of safety, and at a cost of approximately 40 percent. It is because of these factors that underground storage of LPG is becoming increasingly popular. —The End

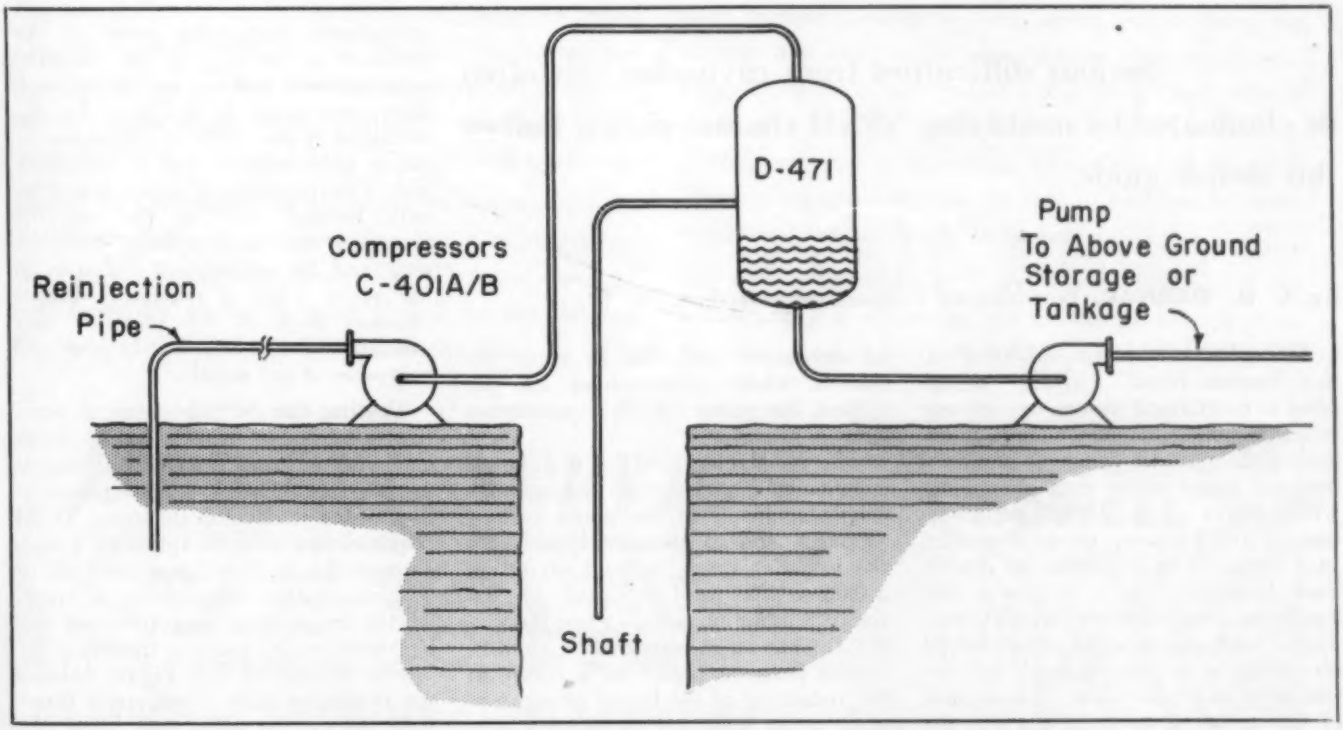
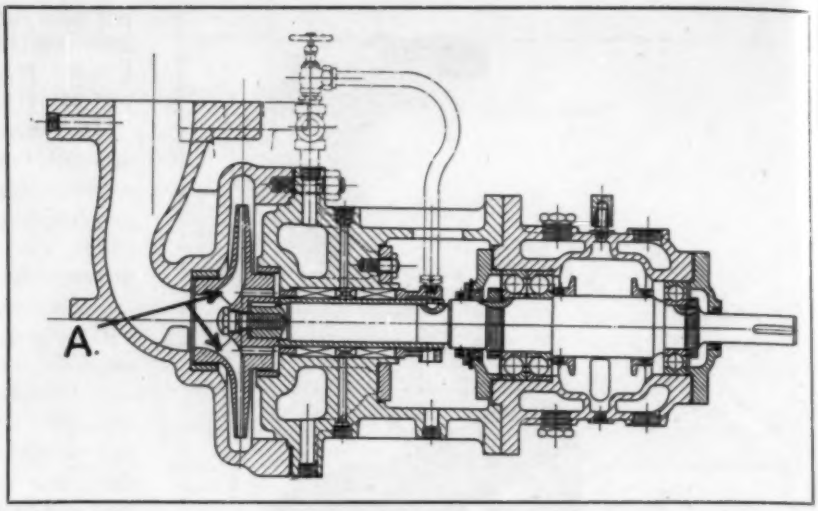


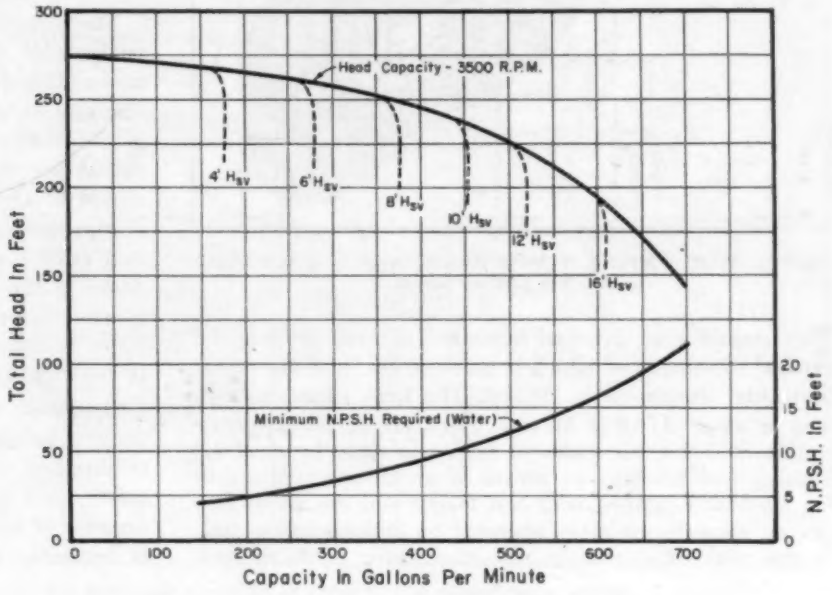
Figure 3. Simplified flow sheet indicates the methods of propane filling and removal.

Figure 1 (top): A. is low pressure area where cavitation starts.

Figure 2 (bottom): Three-inch process pump—NPSH test with water. Dotted line shows deviation from normal when NPSH is limited.

Cavitation Versus NPSH Requirements





Serious difficulties from cavitation can often be eliminated by modifying NPSH characteristics. Follow this simple guide.

By L. H. GARNAR, Worthington Corporation, Harrison, N. J.

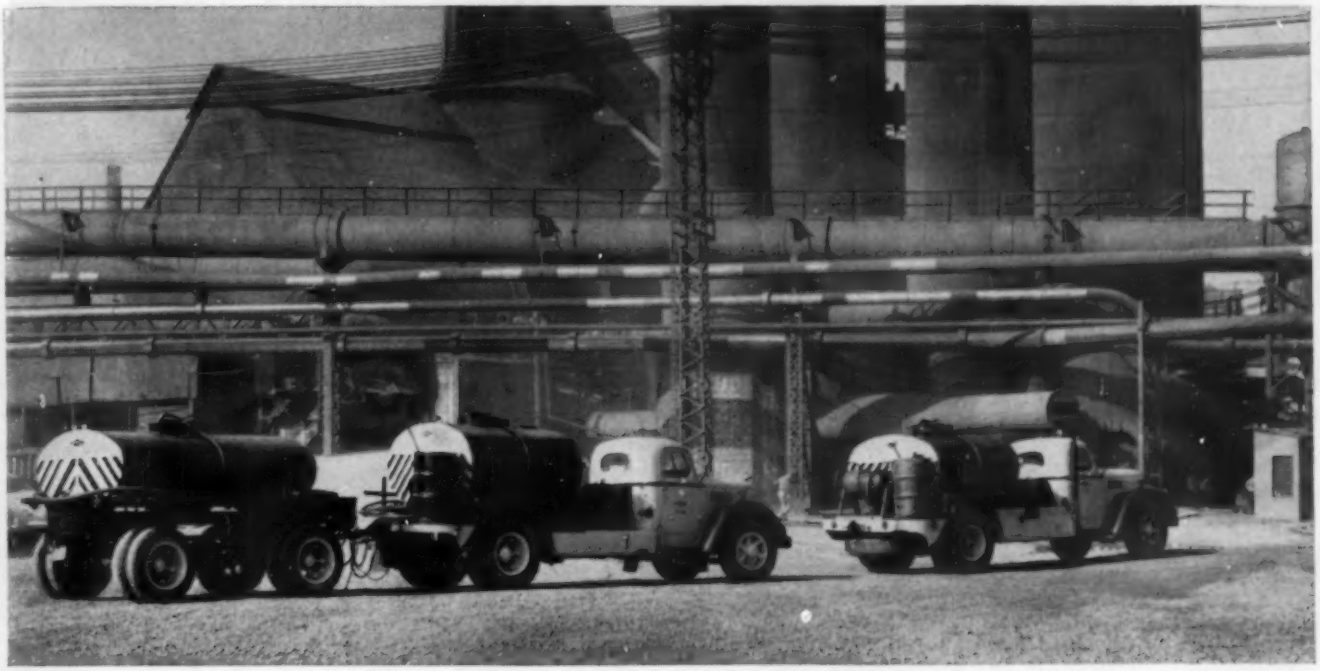
THE SIGNIFICANCE of "Net Positive Suction Head" (NPSH) as applied to centrifugal pumps has become recognized in the petroleum industry during the past ten years. A standard item on many pump data sheets, the NPSH curve is considered an important part of a process pump characteristic curve. It is important to the refiner because it may determine the maximum thruput of a unit and it may dictate such costly items as the height of vessels above the ground and the size of piping and valves. The purpose of this article is to point out that the liquid pumped influences the effects of cavitation and that in many instances when hydrocarbons are involved, the pump NPSH requirements may be modified.

The NPSH required by a pump is a measure of the energy necessary to overcome losses in the pump suction passages and to transfer liquid into the impeller vanes, without cavitation affecting the performance of the pump. Cavitation occurs when there is the formation of vapor-filled cavities in the pumped liquid as a result of the reduction of the liquid pressure at some point sufficient to cause a portion of the liquid to vaporize. In a centrifugal pump, the point of low pressure is usually at the impeller vane entrance and any cavitation starts there (see point A in Figure 1). Actually, it is the effect of cavitation on pump performance that is objectionable. The formation of vapor interferes with normal flow in the impeller changing the head-capacity relationship and the subsequent collapse of the vapor when it reaches a higher pressure area of the impeller may promote noise, vibration, erosion and corrosion of the metal.

Testing for NPSH—General practice is to design process pump impellers with as low NPSH requirements as possible. The complete pump is then tested to develop its actual NPSH requirements over its operating range. Two of the most common methods of test use water, either from a vessel where temperature and pressure can be varied or by using a throttling device in the suction line. Figure 2 shows the results of such a test on a three-inch pump, the solid line being the normal head-capacity curve and the

600 FEET OF COKE OVEN GAS MAIN CLEANED CHEMICALLY WHILE IN USE

DOWELL-designed jet nozzle removed brittle deposits from 30-inch gas line under pressure



Tar and naphthalene deposits had accumulated in a 600-foot section of a steel company's 30-inch gas main. The line supplied coke oven gas to a strip mill two miles away. Pressure drop through this line had doubled, forcing the company to buy large quantities of natural gas to supply the strip mill. The company's attempts to clean the line with steam and hot water failed . . . then Dowell was called.

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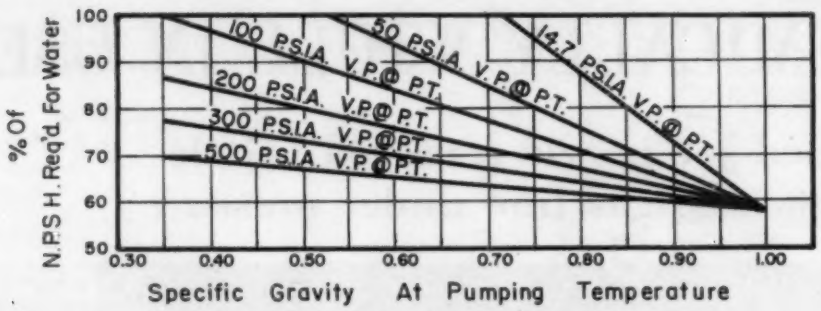


Figure 3. NPSH correction chart for hydrocarbons.

(Reprinted from Standards of Hydraulic Institute, Copyright, 1951, by Hydraulic Institute, 122 East 42nd Street, New York)

dotted lines showing the deviation from normal when the NPSH available (Hsv) is limited. The brakehorsepower and efficiency curves are omitted for the sake of simplicity. The curve plotting NPSH required against capacity shows the minimum pump performance. While the pump actually delivered 375 gpm at 8 foot NPSH, the curve shows 350 gpm as this is on the normal head-capacity curve before the "break" starts. Such tests are run with water which is a single component liquid, having definite vapor pressure-temperature values. When the pressure is lowered below the vapor pressure, water will vaporize with only a small percentage (less than 3 percent) of vapor volume required to change the head-capacity curve. The rate of cavitation influences the sharpness of the break.

Pumps selected for a capacity requiring a certain minimum NPSH on water have been found to deliver the same capacity of hydrocarbons at apparently lower NPSH. Others delivered more capacity with the same NPSH proving that under some conditions, the effect of cavitation with hydrocarbons is less drastic than when handling water. This is understandable when it is realized that hydrocarbons are generally mixtures with a boiling range instead of a boiling point and that when the pressure is reduced below the vapor pressure only the most volatile fractions are vaporized. The vapor pressure of the remaining liquid drops increases, thereby increasing the available NPSH. The amount of pressure drop to cause sufficient vaporization to affect pump performance is a function of the particular liquid and naturally varies with each hydrocarbon mixture. One gallon of 90-F. test water, could produce 3900 cubic feet of vapor at its vapor pressure of 0.256 psia, whereas one gallon of 60-F. pure propane could produce only 4.27 cubic feet of vapor at its vapor pressure of 107.1 psia or 36.4 cubic feet of vapor at 14.7 psia. Thus, it is evident that the quantity of liquid subject to vaporization and the volume of vapor may be less with hydrocarbons mixtures than with water.

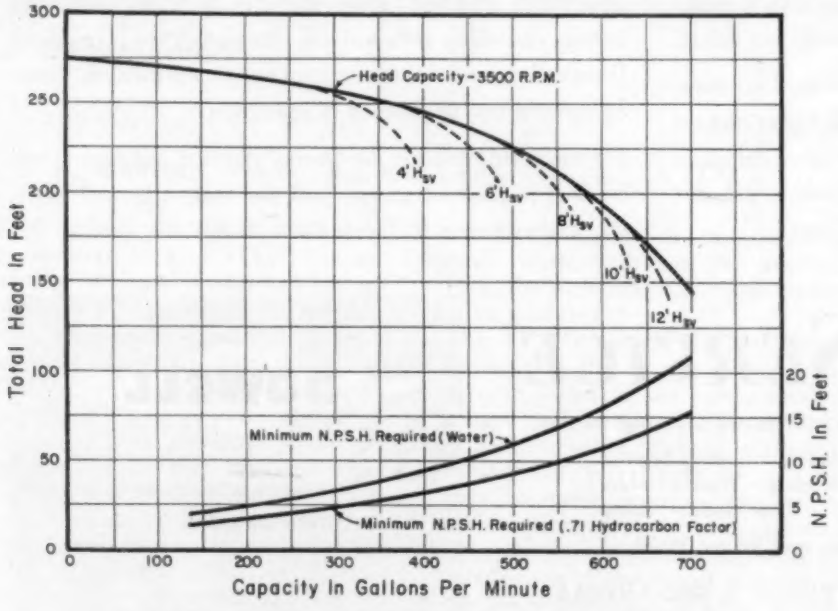


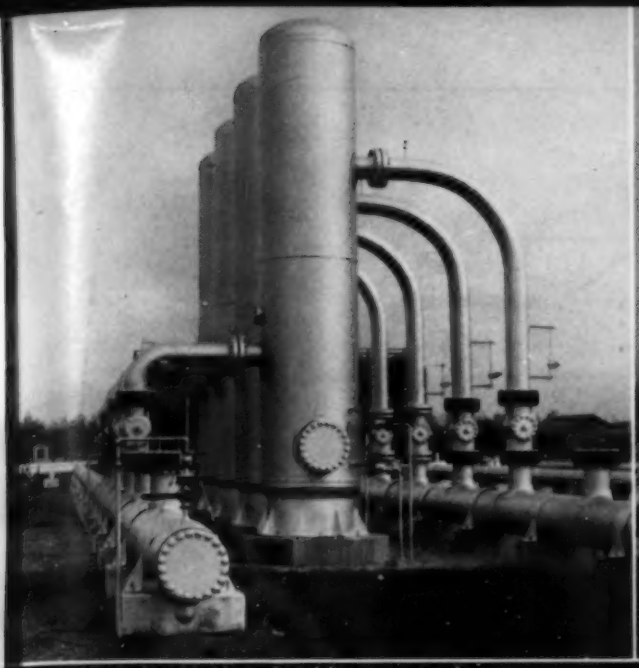
Figure 4. Comparison of hydrocarbon and water NPSH requirements.

Correcting NPSH—The next step is to arrive at a factor, based on the type of liquid, to correct the NPSH available in a system or to modify the normal NPSH requirements of the pump. At present the latter method seems more practical. Based on experience to date, the Hydraulic Institute has prepared a conservative empirical hydrocarbon NPSH correction chart as shown in Figure 3. The specific gravity and vapor pressure at the pumping temperature are used as an indication of the rate and volume of possible vapor formation and this in turn is reflected in the correction factor. For example, if the 3-inch pump in Figure 2 pumped 430 gpm in depropanizer reflux service with a liquid specific gravity of 0.56, and 300 psia vapor pressure, the hydrocarbon correction factor would be 71 percent. The NPSH required would be $10 \times 0.71 = 7.1$ feet in this service, reflecting the relatively small vapor volume at this pressure and the fact that the reflux pressure could probably be lowered without significant vapor formation. Figure 4 shows the hydrocarbon NPSH curve which is 71 percent of the water requirements of the 3-inch pump throughout its range. The dotted head-capacity curve deviation is also less drastic than on water because of the slower rate of vapor formation.

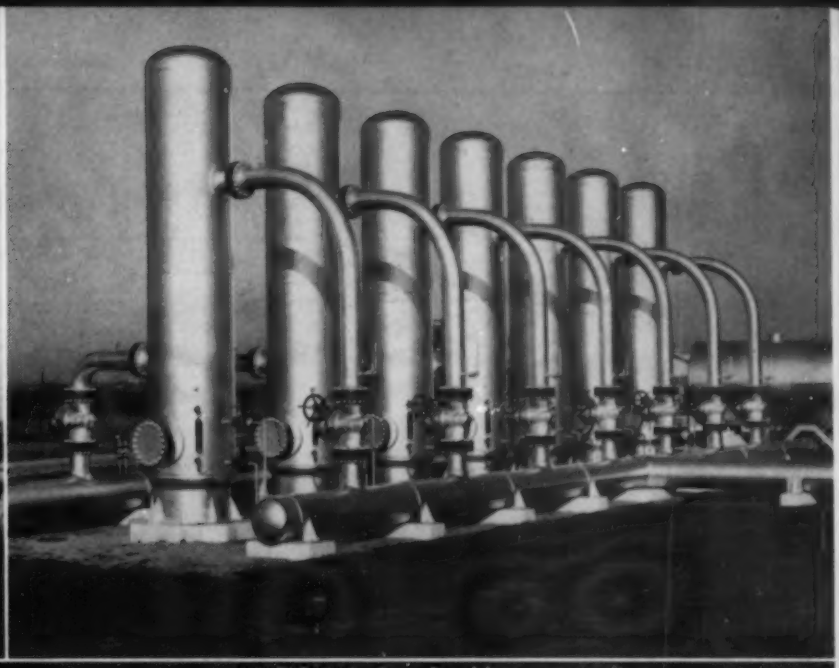
Referring again to Figure 3, the correction for an intermediate cut of 0.65 specific gravity and 50 psia vapor pressure at 450 F. pumping temperature would be 89 percent. Intermediate vapor pressures can be interpolated. No corrections are shown for hydrocarbons having a vapor pressure below atmospheric because where NPSH is involved they would be handled under a vacuum where vapor volumes are large.

Further experience may change the correction values in Figure 3 at some future date, or lead to the preparation of a different method of correction. Actually, the change in the effect of cavitation is a function of the liquid rather than of the pump and it is conceivable that each liquid may someday have a correction factor. The hydrocarbon correction factor relationship to the liquid is the same for any make of pump of similar design. The suggested basis of pump selection and comparison is to obtain NPSH requirements on water and then to apply the same hydrocarbon NPSH correction factor to all pumps.

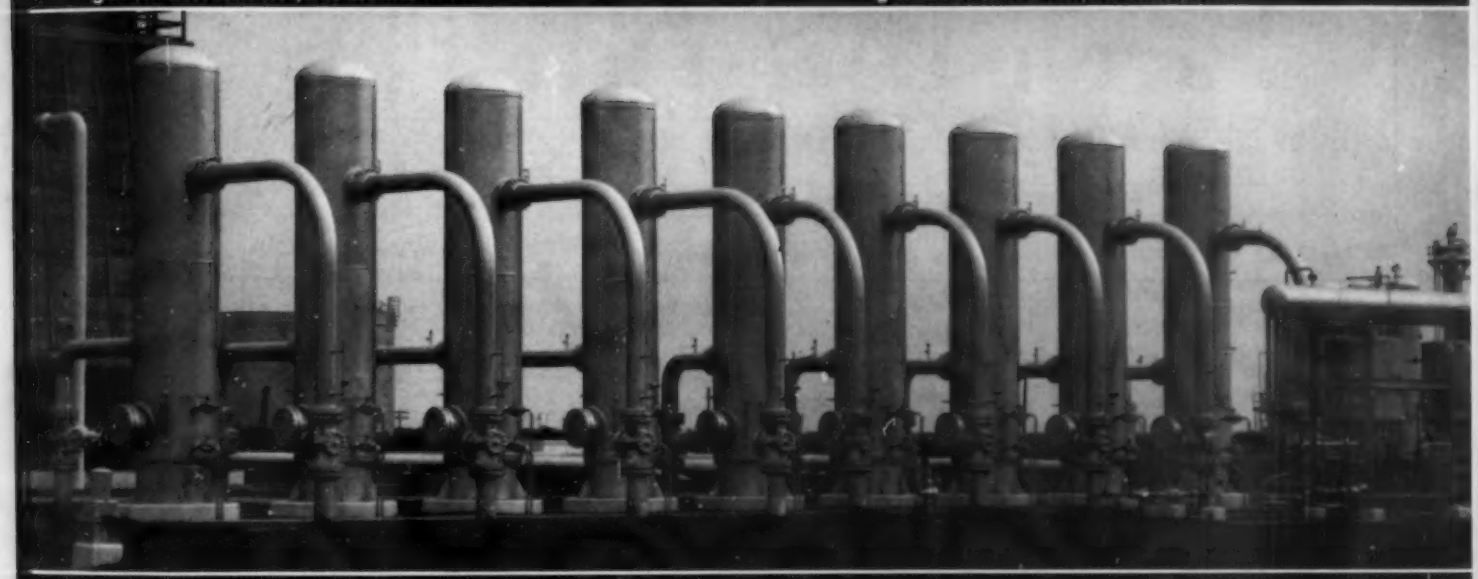
The correction chart should not be used for liquids other than hydrocarbons or where other complicating conditions exist such as air or gas entrainment or pumping close to the cracking temperature. —**The End**



NATIONAL Gas Scrubbers, main line gas booster station, Batesville Miss.



NATIONAL Gas Scrubbers, main line gas booster station, Monroe, La.



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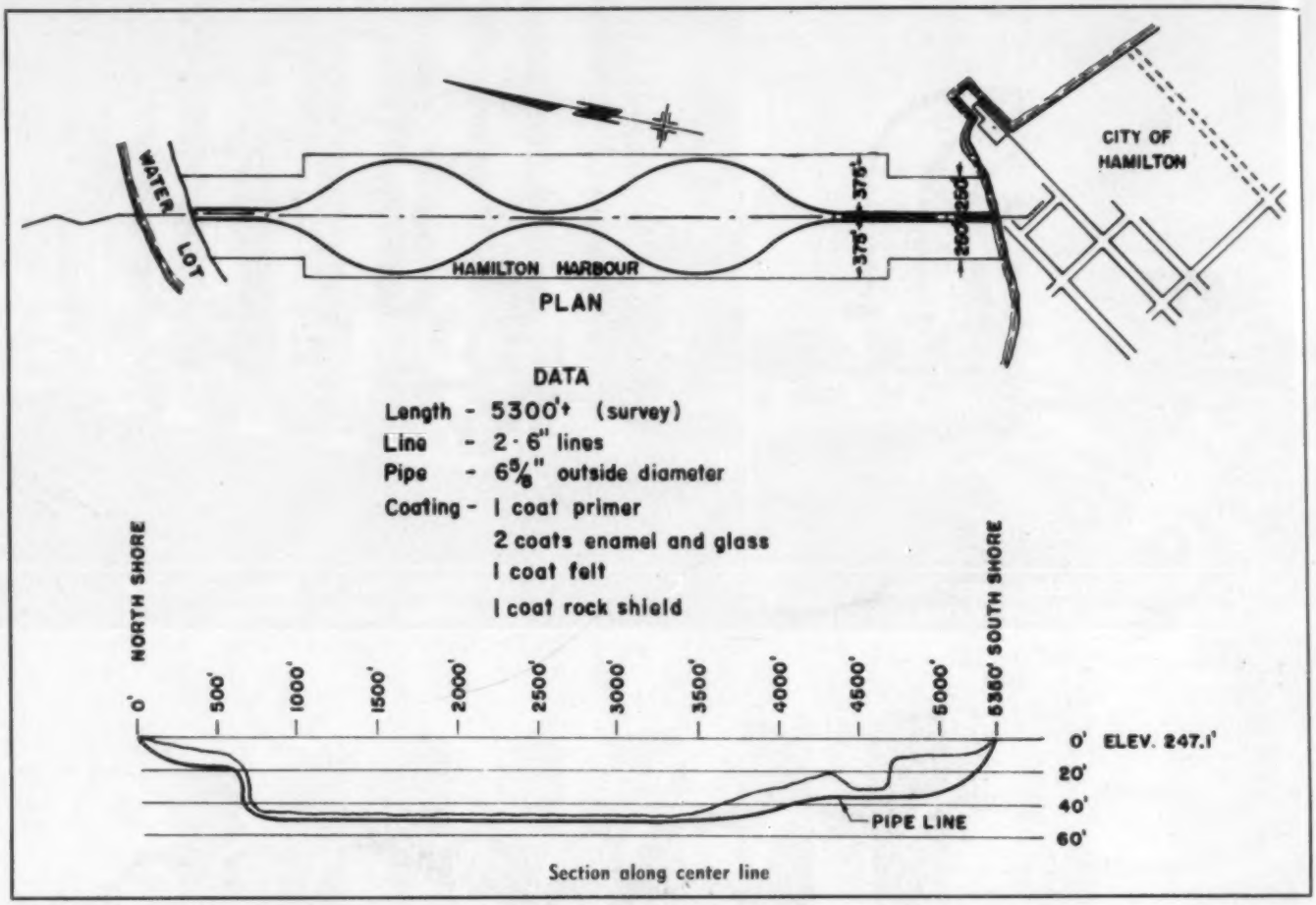

HAMILTON HARBOR CROSSING. Huge slack loops will let pipe continue to settle in the soft mud. Mud goes to depth of 25 feet. Below that is soft silt containing decaying organic material.

Sarnia's Hamilton Harbor Crossing Is Designed to Settle 50 Feet

Underwater lines which would continue to settle indefinitely were the problem. Here's how it was solved with huge slack loops which will allow the line to sink to 50 feet below bottom of harbor.

By B. H. MACKENZIE, Chief Engineer, Pipe Line Department, and
P. T. DUFF, Design Engineer, Imperial Oil Limited, Toronto

PERHAPS THE most difficult single construction problem on the Sarnia Products Pipe Line was the laying of the two six-inch lines across a 5300-foot stretch of the Hamilton harbor. For most of this distance the water is 50 to 55 feet deep and the bottom is composed of soft mud and silt. Borings taken during the initial phases of the job indicated that the lines laid in the harbor would likely continue to settle indefinitely. It was decided to lay the line in such a way that sufficient slack would be provided to allow the line to settle to a depth of at least 50 feet below the harbor bottom.

These two crossings are part of Sarnia's 188.4-mile-long system which runs from Sarnia to Toronto, with a 6.7-mile spur from the main line to Hamilton. This system, which was built by Imperial Oil Limited, is Canada's first major products pipe line. From the initial pumping station at Sarnia to the take-off point for the Hamilton spur at Waterdown the line is 12¾-inch outside diameter

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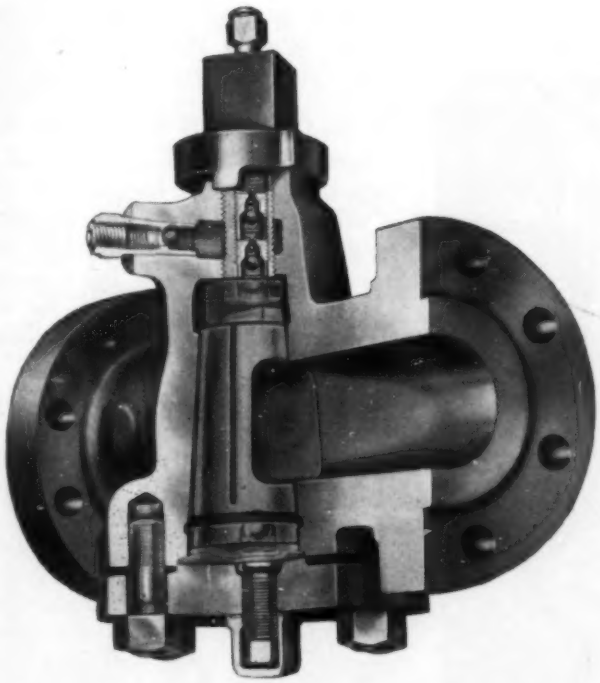

Cutaway view of Nordstrom Hypreseal valve

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In a Nordstrom valve, lubricant is forced through a series of grooves surrounding the plug ports. There it acts as an extra seal against the little leaks that become big problems. It is also forced into a lubricant chamber at the small end of the plug where it serves as a hydraulic jack to keep the plug easy to turn. Finally, it *lubricates* . . . that is, it prevents grinding wear, fills tiny imperfections that may develop, and it lets the plug slide without grating.

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TEN STRINGS, each 1200 feet long, lined up on shore for coating operation.

pipe; from Waterdown to Toronto it is 10¾-inch, and the Hamilton spur line consists of two 6⅝-inch lines.

Two Possible Routes. Initial location work on the spur which connects the main line to an existing market terminal indicated that two possible routes should be investigated. The first route was entirely on land but necessitated a great deal of close construction, passing through a railway marshalling yard and several thousand feet of city streets. The alternate route lay directly across Hamilton harbor and proved to be the most economical.

Soundings Made. With the location established, soundings and core tests were taken on the harbor bottom. A shelf extended about 1400 feet from the south shore at irregular depths, due to the cutting of a 27-foot ship channel which crossed the path of the pipe line. On the north shore a similar shelf extended about 750 feet, at depths varying from about 5 to 10 feet. The main harbor bottom, which lay between the two shelves, had a depth of 50 to 55 feet.

Core tests were taken from a barge, using standard drilling equipment to obtain Shelby tube samples. The shelf adjacent to the south shore consisted of a soft silt containing clay, which would offer support to the pipe. The north shelf consisted of very soft river mud, underlain at depths of 7 to 9 feet with fine sand, which would also support the pipe. The center depression consisted of soft silty river mud to a depth of 25 feet below the harbor bottom. Below the layer of mud, soft silt containing decaying organic matter was found, and although it showed greater resistance to penetration than the mud, its bearing value was doubtful.

From this information it was felt that the line laid across the harbor would continue to settle for years before it would reach a stationary position. It was also evident that in the center portion it would be useless to attempt to dredge a trench to a depth where firm bearing material could be found. Therefore, the decision was made to dredge only the shelves on either side where the two six-inch lines would be laid parallel and backfilled. Across the main harbor bottom the lines would be laid directly on the harbor bottom in large double-bends. These bends would provide sufficient slack for the pipe to settle at least 50 feet below the harbor bottom. Within a very short time the settlement would place the pipe at the six-foot minimum depth required to comply with regulations.

Permission was obtained to use a strip of the harbor bottom 750 feet in width and the bends were designed to depart a maximum of 300 feet from the center line of the crossing. This provided enough slack for the maximum settling without subjecting the pipe to a longitudinal stress.

Construction Begun. Construction work began by making up five 1200-foot strings of pipe for each crossing. The contractor had decided to pull the crossing from the north side, and the unused section of a cemetery was used. While the major portion of the six-inch lines were API specification 5L, Grade A, 0.280 wall thickness, the crossing was 0.432 wall pipe. This was to provide an extra measure of safety on the section laid under water. The pipe was cleaned, primed and given two coats of coal tar enamel.

STRING OF PIPE with rock shield for protection rolls along rubber-tired dollies.

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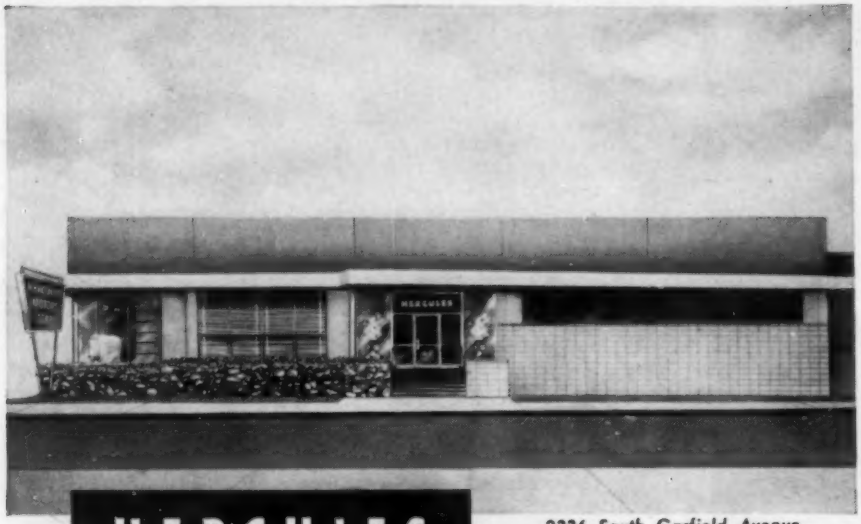

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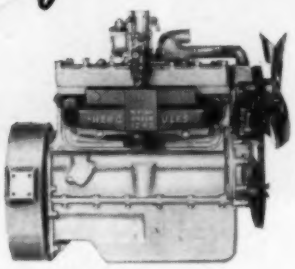
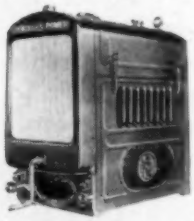
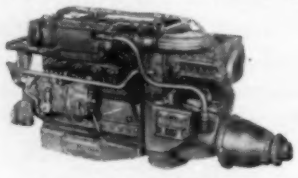


The increased demand for Hercules Engines and Power Units has resulted in a nationwide expansion of Hercules sales and service facilities. The above photograph is of the new Los Angeles branch which is the latest addition to the Hercules sales and service stores.



Facilities of this and other factory branches include: a salesroom, complete parts department, offices and a fully equipped machine shop for engine repair and rebuilding. In addition to the branches in the west and southwest, Hercules distributors throughout the country stand ready to provide immediate service in the following fields; automotive, agriculture, construction, industrial, marine and petroleum.



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The first coat, impregnated with fiberglass, was put on with a standard pipeline wrapping machine, the second being applied by hand. A fiber rock shield was then wrapped around the pipe to protect the coating while the crossing was being installed. All welds were radiographed 360 degrees, using the radio-active isotope iridium 192. This, in addition to visual inspection, prevented the possibility of any inferior welds being installed in the harbor crossing.

While the pipe was being prepared, two dredges were at work excavating the trenches on either side of the harbor. A 12-inch suction dredge, with a capacity of 250 to 400 yards per hour, was used on the south shore approach, dredging a trench having a maximum depth of 25 feet and extending about 1500 feet from the shore. A two-yard clamshell bucket-type dredge was employed on the north shelf, as it was anticipated submerged logs, roots and other debris would be encountered. On this side a trench about 600 feet long, with a maximum depth of 15 feet, was made.

In preparation for the actual work of pulling the strings across the harbor, three lines of buoys were set. Red buoys marked the center line of the crossing and white marked the loops to be put in each line. On the north shore the contractor prepared a series of dollies on which the pipe was to be guided down the bank and into the water. These dollies were made of rubber airplane wheels, mounted in pairs or sets of pairs, so that the pipe would roll on the rubber tires. This particular method was necessary as the actual land in the ravine through which the pipe line passed had special right-of-way restrictions. While the brush could be cut and cleared, no trees were to be removed or damaged; therefore, sufficient right-of-way could not be prepared for the use of side-boom caterpillars to carry the pipe down the slope.

A winch, having a large diameter drum and driven by a portable steam generator, was set up on the south shore. Arrangements had been made to use the pontoons which supported the discharge line from the suction dredge to float the pipe across the harbor. Using several of these to keep the cable supported, a small tug which tended the dredge pulled the

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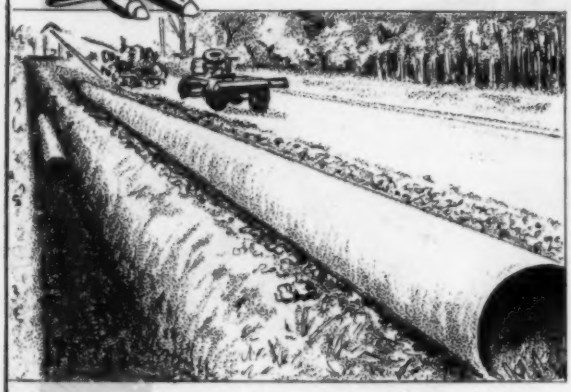

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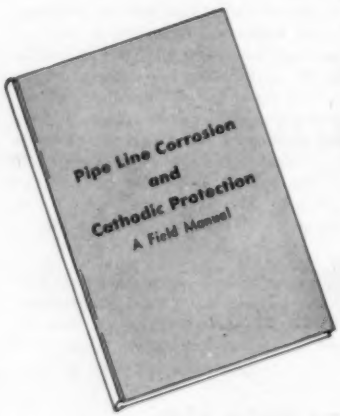

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⅞-inch cable to the north shore in preparation for pulling the crossing.

A radio was set up in the contractor's hut on the north shore, and other two-way sets were provided on the suction dredge, on the two tugs, at the water's edge on the north shore, at the winch on the south shore and in the contractor's superintendent's car. The superintendent supervised and controlled the entire operation from the north bank, being in contact with the over-all operation at all times.

First Launching. The first line was launched late in the afternoon of Sunday, Aug. 31, and by 6 o'clock the following day reached the south shore without mishap. The 0.432 wall pipe—weighing 28.57 pounds per foot—had a negative buoyancy of 7 pounds per foot. As it was pulled into the water, it was suspended by heavy hemp ropes ten feet below the pontoons. These pontoons were attached at 200-foot intervals, and with each pontoon a buoy was fastened to the pipe with depth markers on the cable. These were for checking the depth of the pipe once it had been placed on the bottom. As each section was pulled in, the next section was welded to it. A gamma-ray inspection of the weld was made and, proving satisfactory, the joint was coated, wrapped and the pulling operation continued. This procedure was repeated for each section until the crossing had reached the south shore and was secured.

Loops were then placed in the line by the tugs and the dredge. When the location was reasonably close to the marker buoys, the line was cut loose from the pontoons, using an ordinary hand axe to cut the rope. The pontoons were left attached to the depth buoys and were picked up later by the tugs.

The same procedure was repeated on the second line and both crossings were completed in three days with ideal weather conditions prevailing. When both lines were in position the depths were checked by pulling up the cables on the depth buoys and checking the marks on them. At the same time that the depth was checked, surveyors were triangulating each of the buoys to prepare a final map giving the accurate location of the lines on the harbor bottom. As soon as the survey was completed,

About the Authors

B. H. MacKENZIE, chief engineer, Pipe Line Department, Imperial Oil Limited, was born and educated in Toronto, Canada, receiving his B.S. from the University of Toronto in 1938 in chemical engineering. He joined Imperial Oil at the Company's Sarnia refinery in 1940, and prior to accepting the position of Chief Engineer of the Pipe Line he was co-ordinator for the Sarnia refinery expansion and modernization program.

●

P. T. DUFF is the design engineer in the Pipe Line Department, Imperial Oil Limited. He was educated at Dalhousie University and Nova Scotia Technical College in Halifax, Nova Scotia, receiving degrees in mining engineering. He joined Imperial in 1949 and has been engaged in various phases of pipe line work since.

backfilling of the ditch on the shelves was commenced. The buoys with the marked cables were left attached on the lines in the center section for several days, after which a second check of the depths was made, indicating that settling was taking place slowly. It is planned to make future checks on the depth of the lines using an electronic device from the surface of the harbor.

Before tieing in the harbor sections, pigs were blown through the lines with air. The entire six-inch spur lines were tested hydraulically to 1200 pounds per square inch before being placed in service. All tests proved satisfactory, and the initial delivery of products was made through the line to Hamilton terminal on Oct. 8, 1952, when the remainder of the line had been completed.

General contractor for the crossing was Comstock Midwestern Limited, pipe line contractors of Leaside, Ontario. The dredging was done by McNamara Construction Company, Toronto, who also provided the surface craft for the job. Soundings and core tests were made by Construction Borings of Montreal.—**The End.**

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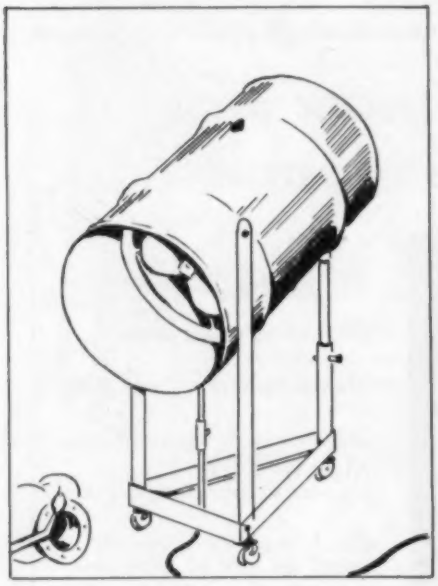

Welder Can Make Exhauster From Discarded Materials

A device to make the job both safer and more comfortable was invented by an on-his-toes welder. The "exhauster" shown here removes smoke and heat, and since it is made of discarded and essentially worthless materials, can be easily duplicated.

Starting point is that old standby, the discarded 55-gallon drum. Inside is a small fan, about 100 cubic feet per minute, rigidly mounted on welded supports. The fan draws the air away from the welder, keeping his surroundings free of smoke and heat. Supporting brackets for the exhauster are designed so that the fan can be raised or lowered to any position, insuring maximum efficiency and least possible interference with the welder's work.

HOW DO YOU LIKE IT?

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Tool Cuts Down Time for Tapping Jobs

A handy tapping device used to tap an oil and pressure loaded pipe line to tie in a subordinate line cuts down the time required to do the job and provides safety for the men using it.

With this tool, which was devised by a field mechanic in East Texas, three men can do the job in 45 minutes. There is a protective covering over the threaded rod atop the tool and a bleeder valve at its base to release pressure. Learning to use the tool takes only minutes.

A coupling is welded to the loaded line, a full opening valve between two short nipples is mounted on the coupling and the tapping tool on top of the entire assembly. Connected next to a rear truck wheel power source by two universal joints and an extension drive shaft, the bit goes to work on the line and some 45 minutes later the tap is through. The large valve is quickly closed and a one-fourth-inch bleeder valve opened on the machine while it is being dismounted. If no connection is to be made immediately after tapping, the pressure can be closed off with a bull plug inserted through the gate valve opening.

Truck Makes Platform for Skip Loader

Pouring the elevated foundations of engines and compressors in a pipe line booster station under construction presented a problem to one contractor. The job was not large enough to warrant setting up mixers, or a conveyor system, inside the partially-completed structure and to have wheeled the cement up the ramps by wheelbarrows alone would have been too time-consuming.

Having a skip loader on the job, along with a two-wheel trailer and

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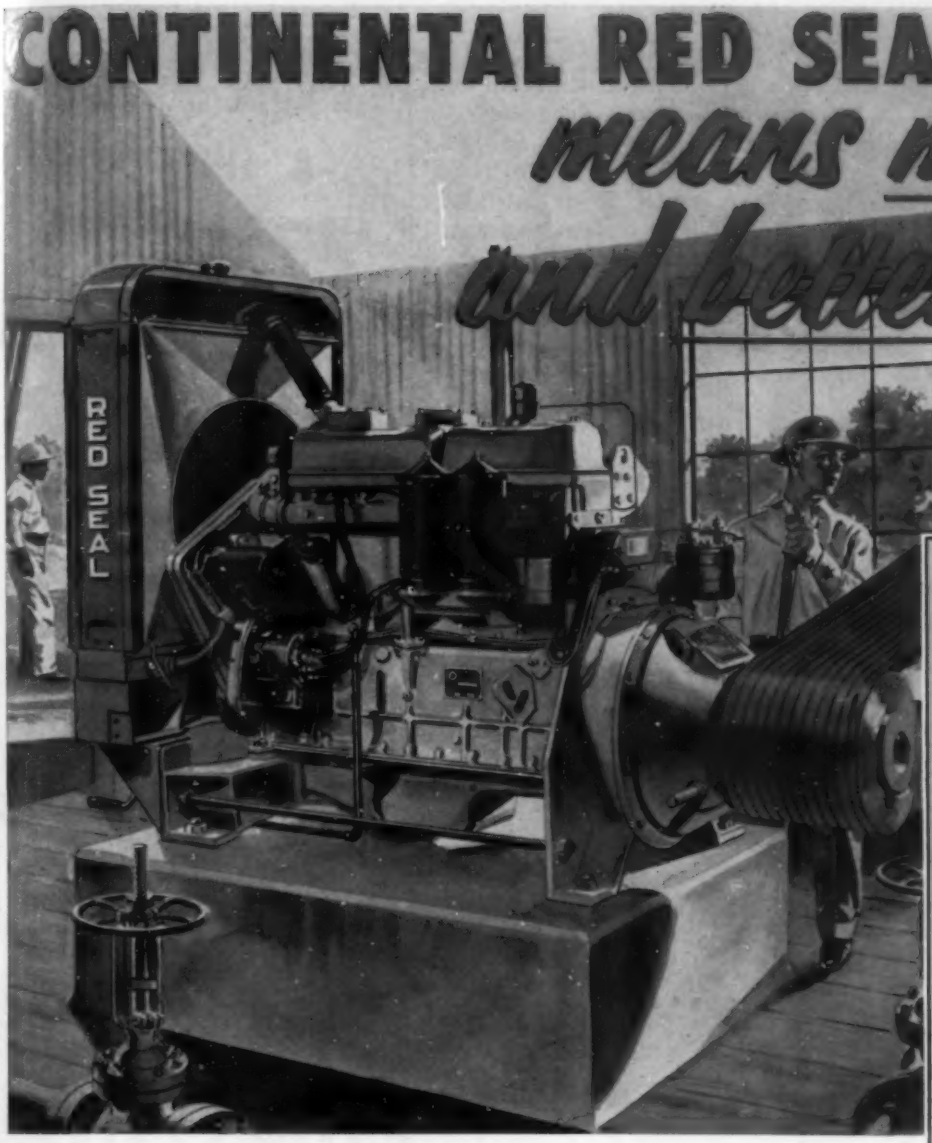

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•

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•

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•

LEAKPROOF WATER PUMP

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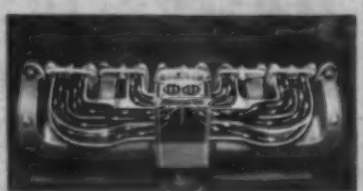
POSITIVE ROTATION EXHAUST VALVES



This patented and exclusive Continental system of Individual Porting is only one of many features which join to assure top performance in Continental Red Seal engines and power units. Arrows indicate how its scientifically located and designed galleries deliver uniform fuel charge to all cylinders.

Continental Red Seal engines for oil field use cover a wider power range today than ever before. If your requirement falls between 2 hp and 1,000, and if *dependability* is just as important as power, there's a Red Seal model built to meet it—and that Red Seal is your one best bet. Ask your oil field supply store, or write the nearest Continental office.

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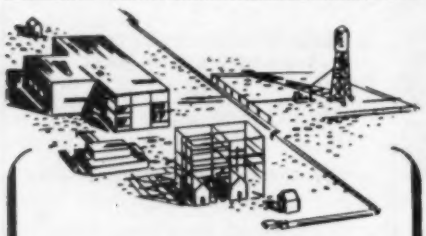

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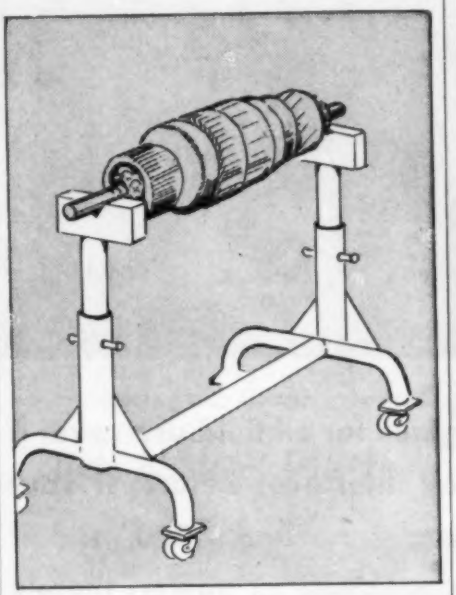
HINTS . . .

an extra flat-bed truck, he set up the units as shown in the accompanying photograph. Spotting the flat-bed alongside the building and lashing the inclined trailer to it at right angles, using load binders to chain the two units together securely, he provided the ramp and platform which provided access, plus the necessary elevation, to permit using the skip loader for transporting cement between mixer and the job site.

The cement was moved to the place where needed as cement was poured around carefully-placed reinforcing rods and anchor bolts.

The arrangement saved many manhours in the pouring operation without the expenditure of money for equipment not otherwise needed during the remainder of the station construction job.



Adjustable, Mobile Stand Aids Generator Handling

The simple stand shown here makes rotor or generator handling far more convenient. As can be seen, it was built from sections of two and three-inch pipe, bent to the desired shape. The level of the stand is adjustable and, once in place, can be securely fixed with the four thumbscrews indicated. The rotor itself is suspended on notched blocks of two-by-four. The entire assembly is on casters to facilitate ease of movement around the shop building.

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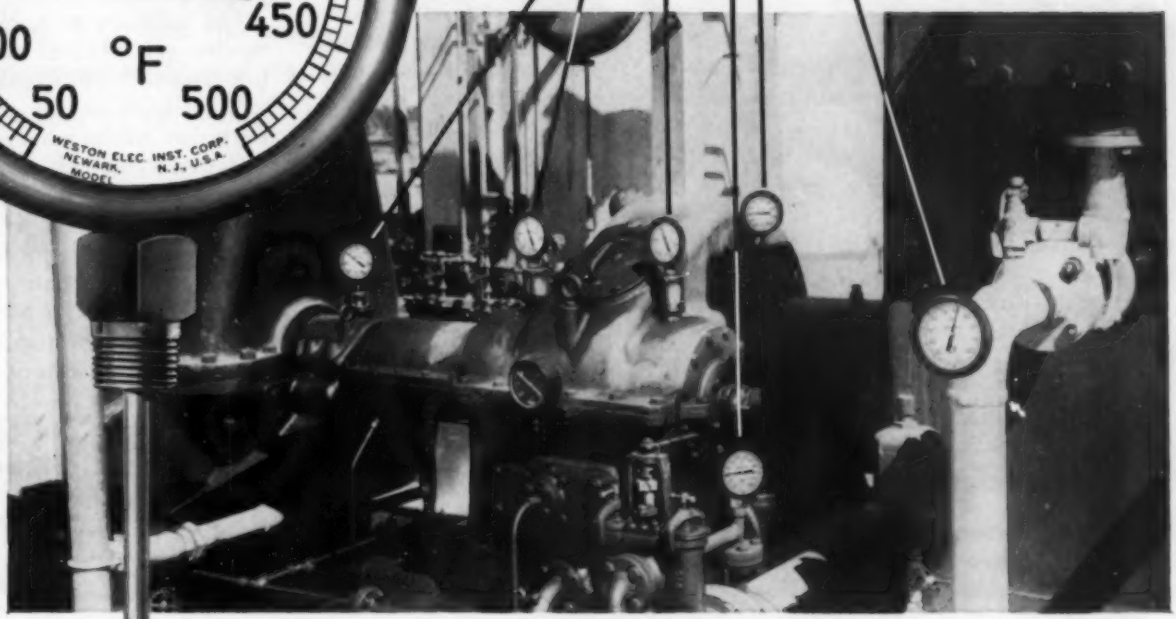

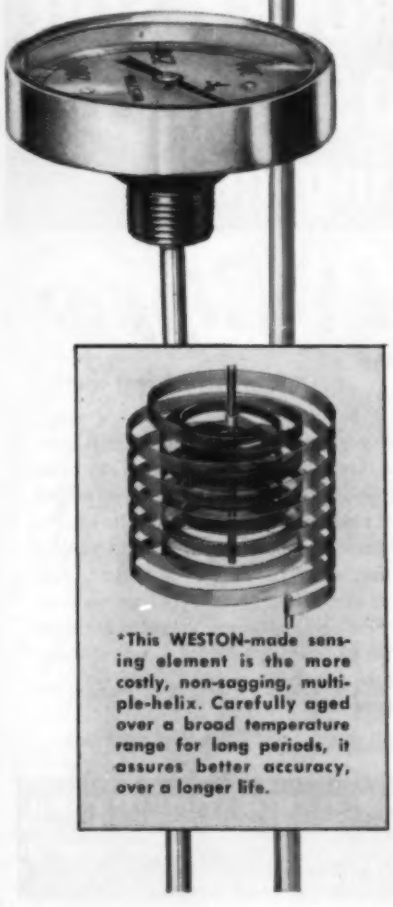

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(with Multiple Helix)*

Here's another typical example of how large processing plants have solved temperature checking problems, and cut thermometer costs besides. With a WESTON dial-type thermometer at every checkpoint, temperatures are read at a glance . . . in far less time, and with far greater accuracy. Their sturdy all-metal construction resists breakage, gives them far longer life on operating equipment. And the exclusive WESTON multiple helix employed assures dependable accuracy during all this long life.

Available in a broad selection of types, sizes, ranges and stem lengths, WESTON thermometers are today standard on all types of mobile and stationary equipment and machines, large and small; as well as on piping, conduit, ducts, etc. Ask your distributor, or local WESTON representative for complete information, or write for descriptive bulletin . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON 5537 *Thermometers*

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By **MADELINE BYNUM,** PIPE LINE INDUSTRY Staff

Texas Eastern Applies to FPC For Conversion of Little Inch

Texas Eastern Transmission Corporation, has filed an application with the Federal Power Commission which, if granted, will make the company one of the largest common carriers of petroleum products.

The plan contemplates the reconversion to petroleum products transportation of that portion of the company's Little Inch gas pipe line extending approximately 1168 miles from a point near Baytown, Texas, to Moundsville, W. Va. The 20-inch diameter line now transports about 200 million cubic feet of natural gas per day. On conversion it would be capable of transporting a maximum of 235,000 barrels of petroleum products per day.

In the application to the FPC seeking permission to remove this portion of the Little Inch from gas service, Texas Eastern also seeks authorization to construct substitute natural gas facilities estimated to cost $71,814,000 in order to maintain the natural gas system's present delivery capacity of more than 1.2 billion cubic feet per day.

These substitute facilities would include approximately 382 miles of new 24-inch pipe line extending from Beaumont, Texas, through the prolific natural gas-producing area of Southern Louisiana to connect with the company's 30-inch pipe line at Kosciusko, Miss.

According to George T. Naff, president, the project as planned will: (1) achieve greater flexibility for the natural gas system while at the same time maintain the present volume of natural gas deliveries; (2) decrease slightly the cost of making natural gas deliveries to customers; and (3) result in a revamped natural gas system susceptible of additional increases in capacity later on without any material increase in the average transportation cost.

"In addition to achieving a more flexible and efficient natural gas pipe line system," Naff, said, "our plan will establish an oil products transportation system which will enable us to provide common carrier service on a most economic basis to the Mississippi and Ohio River valleys and should add materially to the earning power of the company.

The Little Inch is ideally suited to products transportation since it was constructed and operated for that purpose during World War II. It originates in the Baytown-Beaumont refining area and will serve many important marketing areas not presently accessible by products pipe line."

The gross book value of the facilities contemplated for transfer to the

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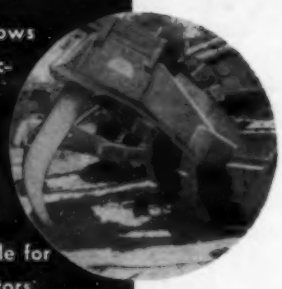

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products pipe line system is approximately $64,400,000 and an initial expenditure of about $13,000,000 would be made to place it in operation.

The application for new natural gas facilities in addition to the 382 miles of 24-inch pipe line provides for construction and operation of approximately 99½ miles of lesser diameter pipe line, ten new compressor stations totaling 86,900 horsepower, and additions to existing compressor stations amounting to 36,200 hp.

More Construction News on Page 96

Pipe Line Contracts Not Let

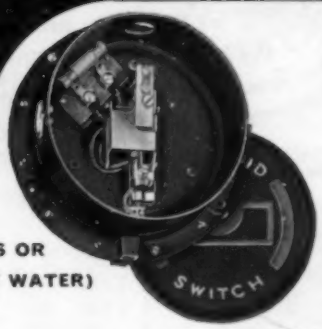
COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
American Louisiana Pipe Line Co.—666 Penobscot Bldg., Detroit	1289	22 & 30	Gas	Arcadia, La.—Near Detroit, Mich.	$130 million	Proposed
American Pipe Line Corp.—New York City (Swinerton & Walberg, San Francisco—Engineering)	1425+ 485 mi. feeders & distribution lines	24 & 26	Products	Beaumont, Texas area—Newark, N.J.	$170 million	ODM granted 40 % tax write-off. Backers working on financing.
Anadarko Basin Pipe Line Co.	525	24	Gas	Wise County, Tex.—To Texas Eastern near Memphis, Tenn.	.....	Planned
Arapahoe Pipe Line Co.—Hutchinson, Kan. (Sinclair Pipe Line Co.—Independence, Kan.)	494	20—24	Crude	Merino, Colo.—Humboldt, Kan.	.....	Planned
Arkansas-Louisiana Gas Co.—Slattery Bldg., Shreveport	136	6 to 24	Gas	Loops along system to increase deliveries to 816 mmcf.	$10,072,000	Authorized by FPC 8½ miles already constructed.
Atlas Corp.—Dresser Industries	400	16	Crude	Neuguen to Bahia Blanca, Argentina	$40,000,000	Planned
Badger Pipe Line Co.—Bartlesville	196	8, 10 & 12	Products	Chicago to Madison, Wisc.	$15 million	one contract let
H. W. Bass & Sons Co.	152	4 & 6	Products	Duval, Live Oak Counties to Corpus Christi, Tex.	.....	Planned
California-Oregon Pipe Line System	103	6	Crude	Crescent City, Cal., to Medford, Oregon	.....	Planned
Carolina Natural Gas Corp.—701 Wilder Bldg., Charlotte, N.C.	185	2 to 12	Gas	Laterals from Transcontinental Gas Pipe Line	.....	Proposed
Central Hudson Gas & Electric Corp.	48	12	Gas	Albany to Kingston, N.Y.	.....	Applied to FPC
Cities Service Gas Company—1st Nat. Bank Bldg., Oklahoma City	33	20 & 26	Gas	To replace lines in Kansas & Missouri	$1,860,000	Authorized
City of Dalton, Ga.	39	8	Gas	To connect with Southern Natural Gas	$2,940,000	Proposed
City of Fayette, Ala.	20	8	Gas	To connect line with Southern Natural Gas	.....	Approved
Coast Counties Gas & Electric Co.—369 Pine St., San Francisco 4	40	3, 4 & 8	Gas	Coast and Valley region	.....	Planned
Colorado Interstate Gas Co.—Colorado Springs, Colo.	365	22	Gas	Rock Springs, Wyo. to Denver, Colo.	$23,299,000	Authorized by FPC
	114.9	4, 6, 8	Gas	Denver Julesburg Basin to Basin Cities	?	Before FPC
Colorado-Western Pipe Line Co.—Dallas	708	.....	Gas	Southeastern Colorado fields to Denver plus various laterals.	$30 million	Planned
Colorado-Western Gas Co.	328	.....	Gas	LaPlata County—Pueblo, Colo. Springs and Denver	$21.6 million	Authorized
Compania del Oleoducto Buenaventura Cali, S.A.	90	.....	Products	Buenaventura to Cali, Colombia	.....	Planned
Dixie Pipe Line Company	20	8	Gas	Gwinville field, Miss. to Transcontinental Gas	$425,000	Proposed
Egyptian Government	80	14	Fuel oil	Suez to Cairo	$7,600,000	Contract awarded to SIAM, Italian Co.
El Paso Natural Gas Co.—Bassett Tower, El Paso, Tex.	32.5	.....	Gas	Reagan and Upton Counties, Texas	$799,000	Authorized by FPC
El Paso Natural Gas Co.	74	.....	Gas	Texas, New Mexico, and Arizona	?	Proposed
Empresa Nacional del Petroleo	80	6	Products	Concon to Santiago, Chile	?	Planned
Equitable Gas Co.—420 Blvd. of the Allies, Pittsburgh, 19	12	Various	Gas	Marion and Wetzel Counties, W. Va.	$2 million	Authorized
Gas Service Co., Kansas City	12	.....	.....	Connect with Cities Service Gas Co. line	$650,000	.....
Governments of Southern Rhodesia and Portuguese East Africa	200	.....	Products	Beria, Portuguese Mozambique-Umtalia, Southern Rhodesia	.....	Considered
Great Lakes Pipe Line Co.	163	12	Products	Rosemount to Alexandria, Minn.	.....	Authorized
Home Gas Co., Binghamton, N.Y.	40	12	Gas	Halsey Valley to Westover N.Y. Port Dixon to Deposit, N.Y.	.....	Asking for bids
Hope Nat. Gas Co.—445 West Main St., Clarksburg, W. Va.	33	8, 10 & 12	Gas	Wyoming County, West Virginia-Buchanan County, Va.	.....	Proposed
	19.9	6-16	Gas	Gathering lines to fields	.....	Proposed
Houston, Texas Gas & Oil Co.—4604 S. Main, Houston, Tex.	1200	30	Gas	Louisiana-New York	$150 million	Proposed
International Pipe Line, Inc.—227 N. Colfax Ave., Minneapolis	132	8	Products	Wrenshall, Minn.-Minneapolis Bulk Terminal	$4,250,000	Proposed
Kansas-Nebraska Natural Gas Co.—Phillipsburg, Kansas	223	6 to 12	Gas	Central and Northeast Nebraska	$4 million	Authorized
Lateral Gas Pipe Line Co.—Cedar Rapids, Ia.	27	4	Gas	Grant to Clarinda, Iowa	$267,000	Proposed
Mayflower Pipe Line Co. (Pine Tree Nat. Gas Co.—70 Pine St., N.Y.)	200	.....	Products	New Jersey refining area to New England	?	Planned
Michi, Inc.	220	10	Crude	Highland, Indiana-Michigan refineries	$6 million	Has ODM certificate of necessity
Michigan Consolidated Gas Co.—415 Clifford St., Detroit 26	25.5	12	Gas	Sparta-Muskegon, Michigan plus underground storage area	$13 million	Proposed
Michigan-Wisconsin Pipe Line Company—500 Griswold St., Detroit 26	251.9	4-24	Gas	Wisconsin	$11 million	Proposed
Mid-Saskatchewan Pipe Line, Ltd.	23	?	Oil	Smily field-Karrobert	.....	Proposed
Missouri Public Service Co.—Warrensburg, Mo.	136.4	8-10	Gas	New Franklin, Mo.-Grundy County, Mo. plus laterals	$5 million	Proposed
Montana-Dakota Utilities Co.	49	12	Gas	Montana, S. Dakota and Wyoming	$1,366,944	Proposed
Natural Gas Pipe Line Co. of America—20 N. Wacker Dr., Chicago 6	240	24	Gas	Cater, Garvin and Stephens Counties-Hutchinson County, Texas	.....	Planned
Natural Gas Producers, Inc.—Colorado Springs	100	12	Gas	Yenter pool-Denver	.....	Planned
Nebraska Pipe Line Co.	220	6	Products	Cheyenne, Wyo. to North Platte, Neb.	$4,000,000	Planned, ODM Certificate granted
New River Gas Company	50	?	Gas	Summers-Monroe Counties, W. Va. and Narrows Dublin, W. Va.	.....	Planned
NNCW Pipe Line Company—Dallas	127	8 & 10	Crude	Clareton field-Casper, Wyoming	$3.6 million	Planned
Northern Indiana Fuel & Light Co.—Auburn, Ind.	35	10	Gas	Edgerton to Auburn, Ind.		Planned
Northern Natural Gas Co.—2223 Dodge St., Omaha, Nebr.	167	24	Gas	Farmington, Minn. to Duluth, Minn. and Superior, Wisc.	$12 million	Before FPC
	329	2, 6, 8, 10, 12	.....	Sioux Falls to Aberdeen, S. D.	.....	Proposed
	310	24	Gas	Tioga to Fargo, N.D.	$30 million	Planned
	.....	.....	Gas	To interconnect with Natural Gas Pipe Line	$244,000	Planned
North Dakota Natural Gas Co.—St. Paul	500	10 & 12	Gas	Tioga-Minot, Fessenden, Devils Lake and Fargo, N.D., plus 6" feeder lines	$10.8 million	Proposed
Northwestern Utilities, Ltd.—10124-104th. St., Edmonton	42	12¾	Gas	Canada	$1.4 million	Proposed
Ohio Fuel Gas Co., Columbus, Ohio	24½	20	Gas	Richland & Crawford Counties, Ohio	$1,072,000	Authorized
	46	20-24	Gas	Jackson, Vinton, Hocking & Fairfield Counties, Ohio	$3,832,700	Proposed
Orchard Pipe Line Co.—Denver	45	8	Crude	Orchard-Merino, Colorado	$811,000	Planned
Pacific Northwest Pipe Line Corp.—M & M Bldg., Houston	1466+ 380	main	Gas	San Juan Basin-Pacific Northwestern states	$160 million	Approved
Panhandle Eastern Pipe Line Co.—Kansas City, Mo.	575	New Line	Gas	Kansas-Michigan	$67 million	Before FPC
	398	Loops & Laterals	Gas	Kansas-Michigan		
Pawnee Pipe Line Co.	35	6-10"	Crude	Adena Field to Merino, Colo.	.....	Approved
Pembina Pipe Line Co., Ltd.—Calgary	325	3-12	Crude	Pembina Field-Edmonton	$5½ million	Preliminary
	72	16	.....	Transmission	$13 million	Permit granted
Petroleos Mexicanos—Ave. Juarez 94, Mexico City	440	20	Nat. Gas	Brazil-Tampico-Posa Rica, Mexico	.....	Planned
	260	6 & 8	Products	Lagos, Mexico-Guadalajara, Aguascalientes and Salamanca	.....	Planned
	145	12	Crude	18 de Marzo field-Monterrey, Mexico	.....	Considered
	72	12	Crude	Posa Rica-Atzacapotzalco, Mexico	.....	Proposed

Pipe Line Contracts Not Let (Continued)

Phillips Petroleum Company—Bartlesville	52	10	Products	Shell's Brookshire system-Sweeny, Texas	.....	Planned
	54	6	Products	Goldsmith-Borger, Texas	.....	Planned
	44	10	Products	Paola, Kansas-East St. Louis	.....	Planned
Phillips Pipe Line Co.	71.5	8	Products	On the Borger to E. Chicago Line	$1,862,200	Out for bids
Pine Tree Natural Gas Co.	204	Undermined	Gas	Boston area-Bangor, Maine	.....	Planned
Pittsburgh Consolidation Coal Co.	100	.....	Coal	Cadiz, Ohio to near Cleveland	$10 million	Planned
Progress Pacific Pipe Line Co.—530 West 6th St., Los Angeles 17	1100	24	Crude	Odessa, Texas-Los Angeles Harbor	.....	Planned
Shamrock Oil & Gas Corp.—1st Nat'l Bank Bldg., Amarillo	55	6	Products	McKee-Amarillo, Texas	$1 million	Planned
Shenandoah Gas Co.—Lynchburg, Va.	40	.....	Gas	Virginia Gas Transmission Co., System-Virginia and W. Virginia towns	$1½ million	Authorized
South Georgia Natural Gas Co.	220	Various	Gas	Lee County, Ala.-Georgia & Florida	$8,969,000	Proposed
South Saskatchewan Pipe Line Co.—Socony-Vacuum—Woodley—Canadian & Southern Production	155	16	Crude	Fosterton field to Regina	.....	Permit granted
Sunflower Pipe Line Co.—Tulsa	265	3 to 6	Products	Kearny, Grant and Haskell Counties, Kansas to Wichita, Kansas	$3½ million	Planned
Standard Oil Co., of Texas	250	.....	Products	El Paso to Albuquerque	$4 million	Surveying
Texas Gas Corp., Shreveport, La.	3.5	12	Gas	Sabine River crossing to join Trans-Continental Gas Pipe Line	.....	Authorized
Tennessee Gas Transmission Co.—Box 2511, Houston 1.	50	10	Gas	Nueces County, Texas	.....	Proposed
	243	24	Gas	Hebron Storage field, Pennsylvania-New York-Connecticut line & lay 225 mi. of 30" from Castor, La. to Kosciusko, Miss.	.....	Proposed
Texas Eastern Transmission Corp.—Texas Eastern Bldg., Shreveport	329	16 & 24	Gas	Reconvert "Little Big Inch" line	$78.8 million	Proposed
Texas Eastern Transmission Corp.	58	16 & 20	Gas	Joaquin to Longview	$3,269,000	Proposed
Texas Eastern Transmission Corp.	?	?	Gas	Reynosa to Texas Eastern line	.....	Planned
Texas Gas Transmission Co.—416 W. 3rd St., Owensboro, Ky.	48	26	Gas	Lake Cormorant, Miss.-Slaughter, Ky.	$4¼ million	Proposed
	24	16	Gas	Acadia & Jefferson Davis Parishes	.....	Authorized
Trans-Canada Pipe Line, Ltd.	2240	30 & 36	Gas	Alberta-Eastern Canada	$300 million	Approved
Transcontinental Gas Pipe Line Corp.—3100 Travis St., Houston 6.	57	30 & 36	Gas	Parallel existing system in Louisiana, Mississippi and Alabama	$61½ million	Authorized by FPC
	.....	.....	Gas	Connecting facilities with Texas Eastern-Penn. Jersey Trans. Corp. at Montgomery County, Pa., and Linden, N.J.	$131,628	Authorized by FPC
	533	30 & 36	Gas	Paralleling portions of Texas-N.Y. line	$80 million	Proposed
	25	.....	Gas	Cameron & Calcasieu parishes, La.	.....	Proposed
Triangle Pipe Line Co.	560	12	Products	Arkansas City, Kansas-Covington, Ky.	$24½ million	Proposed
Union Gas Co. of Canada, Chatham, Ont.	180	.....	Gas	Dawn Gas field to Lamberton County to deliver Gas to Dominion Gas Co.	?	Planned
Union Oil Co. of California—Union Oil Bldg., 617 W. 7th., Los Angeles 17.	65	12	Crude	Santa Clara Valley field-Wilmington refinery	.....	Proposed
United Fuel Gas Co.	10.5	12	.....	Wood County to Lanham, W. Va.	.....	Before FPC
	600	.....	Products	Under study to supply naval base and four air bases in Spain	$16 million	Under study
Utah Natural Gas	40	16	Gas	Orem to Salt Lake City, Utah	.....	Planned
Virginia Natural Gas Company	153	.....	Gas	Buckingham to Richmond & Portsmouth, Va.	.....	Planned
West Coast Pipe Line Co., Mercantile Bank Bldg., Dallas	960	24 & 26	Crude	Wink, Texas-Norwalk, California	$106,000,000	Planned
Western Pipe Lines, Ltd.	80	20	Gas	Niagara Falls-Ontario	.....	Construction Started
Williston Basin Pipe Line Co., Insurance Bldg., Omaha	244	8	Products	Billings and Laurel refineries-Glendive, Mon.	.....	.....
Wyoming Gas Products Corp.	.....	.....	Gas	Gathering system, Weston County, Wyo. to feed gasoline plant	.....	.....
Yacimientos Petroliferos Fiscales Bolivianos	170	4	Crude	Bermejo-Tupinsa, Bolivia	.....	Planned

DIFFERENTIAL PRESSURE CONTROLS FOR LOW PRESSURES

MERCURY SWITCH EQUIPPED



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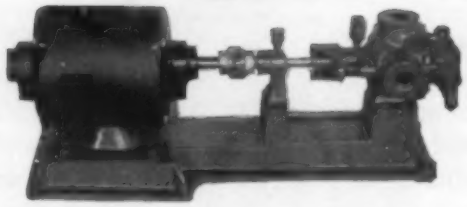

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Cherokee Buys Pipe Lines In Oklahoma and Missouri

Purchase of a 1050-mile crude oil pipe line gathering and trunk system in Oklahoma from Interstate Oil Pipe Line Company, and two crude oil lines extending 395 miles from Glenn Pool, Okla., to Wood River, Ill., from Ajax Pipe Line Company, has been announced by L. F. McCollum, president of Continental Oil Company, and W. Alton Jones, board chairman of Cities Service Company.

The Cherokee Pipe Line Company, of which Conoco and Cities Service each own 50 percent, has been organized to purchase the properties.

Plans call for conversion of parts of the two systems into an eight-inch and ten-inch products pipe line system. Also to be purchased by Cherokee and converted to products transportation is a 32-mile oil line extending from Guthrie to Cushing, Okla., owned by Cities Service and 82 miles of oil line from Tonkawa to Oklahoma City, owned by Conoco. The products line system will then extend 582 miles from Ponca City, Okla., to the Oklahoma City area and to Wood River, just north of St. Louis, and will have an initial daily throughput of 22,000 barrels of petroleum products.

Both Conoco and Cities Service have large refineries at Ponca City. The products line will be operated by Continental Pipe Line Company.

Arapahoe Pipe Line to Run From Colorado to Kansas

Denver-Julesburg crude will be transported to Wood River and Chicago refining areas by the newly organized Arapahoe Pipe Line Company, which will run from Moreno, Colo., to Humbolt, Kansas.

The owners of the line will be Sinclair Pipe Line Corporation, Pure Oil Company and possibly one or two other pipe line companies. Heading up the new company is E. W. Unruh of Sinclair Pipe Line Company; the manager is Karl Feldman also of Sinclair. Company headquarters are at Hutchinson, Kansas.

Texas Illinois to Have Longest Aerial Crossing

Work was scheduled to start early this month on the world's longest aerial pipe line river crossing. It is Texas Illinois Natural Gas Pipeline Company's Mississippi River suspension bridge being erected at Grand

Tower, Ill., about 80 miles north of Cairo.

The bridge will have an over-all length of 3690 — between anchor blocks—with a main span of 2150 feet. It will support two 30-inch pipe lines which weigh in excess of 563,000 pounds.

Trans-Canada Expecting Final Go-Ahead on Alberta Pipe Line

Trans-Canada Pipe Line Company is expecting daily the issuing of an interim permit from the Federal Board of Transport Commissioners for the 2240-mile gas line from Alberta to eastern Canada with an off-shoot to the U. S. Minneapolis market.

In the latter part of June, the company's request was approved in principle but a permit was withheld until more data on the route of the line was placed before the board.

With the issuing of the interim permit, the firm will be able to line up western supplies and estimated markets before completing the major job of arranging financing for the $300 million project. Officials hope a final permit will be issue in time for construction to start in spring, 1955. N. E. Tanner, Trans-Canada president, has predicted that gas will be in Winnipeg by November, 1955.

About Our Authors

A. H. Newberg

E. C. Schuster

The pictures of two PIPE LINE INDUSTRY authors were inadvertently transposed in the July issue. Arthur H. Newberg (left) is chief engineer for Service Pipe Line Company, Tulsa. Edwin C. Schuster (right) is an engineer in the Research and Development Section of Service Pipe Line Company. They were co-authors of an article in the July issue. PLI regrets this error—DMT.

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PIPE LINE INDUSTRY'S VIEWS OF THE NEWS

HEADLINES OF THE MONTH

• Phillips case hopes up to Ike and Congress . . . • Westcoast wants rehearing . . . • Gas pipe line revenues up . . . • $3.9 billion construction expenditure seen . . . • Ike-liked T-H change proposed . . . • President enters tanker building argument . . .

Gas Case Hopes Up to Ike

The ghost of federal regulation which has long hunted the independent gas producers finally escaped from his closet last month, and it will take the President and the Congress to put him to rest.

The Federal Power Commission, reluctant and dissension-torn, took its first uneasy step toward obeying the Supreme Court's mandate in the Phillips case by freezing the wellhead price of natural gas sold by independents to interstate pipe lines.

Without waiting for the High Court's soon-to-follow rehearing denial which erased the last wan hope for judicial relief, the FPC prohibited any change in contracts in force on June 7 or since, except upon application. Sales contracts which were in effect June 7 are to be filed with the agency October 1, and no increase in these rates can be made unless it is first filed with FPC, which has the authority to suspend proposed rate hikes until a hearing is held and a decision reached.

Commissioner Seaborn L. Digby dissented bitterly, saying the FPC had exceeded its rule-making authority by fixing rates retroactively.

Industry leaders agreed—in spades: ". . . intersectional extortion has been legalized and put in official decree . . ." declared Harry W. Bass of Dallas, president of the Texas Mid-Continent Oil & Gas Association.

But by and large there was little protest from the industry, which had its say when the Phillips decision was handed down and has now decided that, as Bass put it: "Our only hope is that Congress will be sufficiently outraged to remedy this situation."

The chances of realizing that hope rests heavily on President Eisenhower, who has a plea from Sen. Lyndon B. Johnson (Dem., Texas) for creation of a study commission which would review the court's edict and make recommendations for an appropriate law clarifying the original intent of the Natural Gas Act.

What will he do? Some industry spokesmen think he will go along. They point out that he is an ardent state's rights advocate and that this is certainly a case where federal jurisdiction has been superimposed upon a strictly state function. They reason, therefore, that he will intervene.

The White House says the Chief Executive has the appeal under study. That is headway, at least, in the absence of a flat turn-down.

Oil-state legislators are solidly behind the Johnson plan. And with their more than considerable influence, the next Congress, whether it be Republican or Democratic, could parlay the commission's findings into a law which could overturn the court's ruling.

Bills to upset the court edict are pending in both the House and Senate but none has undergone hearings and all will die automatically when Congress adjourns. More measures will be introduced in the new Congress in January, but it is expected that the orderly procedure proposed by Johnson will prevail.

Johnson's commission would be composed of representatives of the gas industry, the FPC, state oil and gas agencies, and distinguished Americans. It would study the many complex problems raised by the court's decision, then draft a model bill which the President presumably would send to Congress with an appropriate message.

Westcoast Asks Rehearing

While the independent gas producers were finding themselves enmeshed in government regulation last month, another branch of the industry was considering the future possibility of being involved with two governments at once.

The odd problem arose out of the FPC order giving Pacific Northwest Pipeline Corporation the right to supply natural gas to the northwest through a $160 million line from the San Juan Basin. Loser in the case was Westcoast Transmission Company, Inc., which proposed to ship into the Northwest from the Peace River area of British Columbia and Northern Alberta.

One reason given by FPC for turning down Westcoast's application was that the company's source of supply would be in Canada, and thus outside the regulatory jurisdiction of the commission. FPC declared that there is no "inter-governmental agreement assuring the continued adequacy of this supply."

This statement was attacked by Westcoast in a 39-page plea for a rehearing of the decision. The commission's reasoning, charged Westcoast, amounts to an "embargo" upon the importation of natural gas into the U. S. It noted that the commission held out the possibility of a supplementary gas supply being imported from Canada, but pointed out the difficulty of financing and building a line which would be used on an interruptable basis.

Thus the effect of the FPC finding is to deny the consuming public in the U. S. any opportunity of obtaining a supply of natural gas from either Canada or Mexico unless there is some sort of inter-governmental agreement, Westcoast pointed out.

FPC has 30 days in which to consider Westcoast's rehearing plea. If it denies or ignores the request, Westcoast intends to appeal to the Third U. S. Court of Appeals in Philadelphia.

Pipe Line Revenues Gain

Operating revenues of gas pipe line companies totaled $129.2 million in April and $1.5 billion for the 12-month period, FPC reported. These were gains of 7.8 percent and 20.4 percent over revenues at the same time a year ago.

Operating expenses were up 8.4 percent over April, 1953, with cost of gas purchases rising 9.2 percent and transmission expenses increasing 11.8 percent.

The report declared that the number of ultimate users increased 3 percent from 432,944 to 445,886 during the 12 months. Sales, in thousands of cubic feet, to ultimate consumers increased 10.2 percent.

The figures were based on monthly reports of 36 gas pipe line companies.

Last month the FPC also:

• Authorized Tennessee Gas Transmission Company to acquire by merger all facilities of its wholly-owned subsidiary, Northeastern Gas Transmission Company of Springfield, Mass. Tennessee Gas would continue the same service now performed

by Northeastern, which supplies to New England.

• Postponed until Nov. 4 an oral argument on the desirability of adopting rules concerning automatic escalation and favored national clauses in natural gas purchase contracts by interstate gas companies with producing companies.

• Prescribed rules for natural gas companies seeking to qualify for exemption from FPC regulation under the Hinshaw Amendment. The commission asked that a responsible officer of each gas company affected by the Hinshaw Amendment furnish a written affidavit that all gas it buys and transports is received and consumed within a single state.

• Predicted that annual energy consumption will increase more than threefold from 1953 to 1975 in a report, "Estimated Future Power Requirements of the U. S. by Regions." FPC forecasts that annual energy consumption will rise from approximately 440 billion kilowatt hours to more than 1350 billion kilowatt hours in this 22-year period.

Gas Expenditure Estimated

The gas utility and pipe line industries will spend $3.9 billion on new construction during the four years, 1954-57, it was estimated last month by the American Gas Association. This compares with actual expenditures of about $5.08 billion for expansion in 1950-53.

Expenditures of the industry in 1953 for new facilities aggregated $1.35 billion, the second highest total in gas industry history. Last year was the fourth consecutive year in which new construction expenditures exceeded $1 billion.

Total expenditures for new construction and expansion of present facilities for 1954 are estimated to be about $1.2 billion, with expenditures of $1.15 billion for 1955. Industry estimates for 1956 and 1957 are placed at about $¾ billion each year.

These estimates may prove conservative, since many companies tend to underestimate construction projects for the more remote years. Although in the post-war years, the ratio between available supply and demand for natural gas has gradually lessened there are many factors indicating further growth of demand for gas. More large pipe line projects will be needed to supply industrial and population growth. Though construction expenditures may decline, the reduction from current levels may be more moderate and gradual than indicated in the present estimates.

About 90 percent of the estimated construction expenditures for the next four years, or a total of about $3.6 billion, will be devoted to expansion of the nation's natural gas systems. About $1.71 billion will be spent on natural gas transmission lines and utilities distributing natural gas will spend $1.33 billion for expanded distribution facilities. Natural gas construction expenditures in 1953 totaled $1.25 billion, and it is anticipated that about $1.09 billion will go for natural gas construction in 1954.

For the whole gas utility and pipe line industries, transmission expenditures will amount to $1.72 billion from 1954 through 1957. About $1.6 billion will be spent on all types of distribution and $327 million will be spent in expanding underground storage facilities in the next four years. The distribution expenditures for the 1954-1957 period are greater than in comparable period from 1950-53, when about $1.4 billion went into expanded distribution facilities.

A large proportion of the companies reporting anticipated construction expenditures also indicated their expected methods of financing. Such estimates showed these companies expected to obtain 35 percent of the needed funds from internal sources; 47 percent of the new money would come from debt issues, and the remaining 18 percent from equity issues. Compared with similar forecasts made one year earlier, there appears to be an increase in the supply of internally-generated funds, and virtually an equal decline in reliance on debt and equity sources for money.

Gas Utility and Pipe Line Construction Expenditures, by Type of Gas and by Plant Function, 1953-1957

(Millions)

Type of Gas and Plant Function	Actual 1953	FORECAST 1954	1955	1956	1957	Total Forecast 1954-1957	Actual Total 1950-1953
Natural Gas-Total	$1,252	$1,088	$1,055	$709	$699	$3,551	$4,687
Production and other storage	172	74	67	54	56	251	509
Transmission	673	613	568	260	267	1,708	2,746
Underground storage	44	50	24	27	13	114	155
Distribution	315	312	357	331	331	1,331	1,109
General	48	39	39	37	32	147	168
All Other Types of Gas-Total	98	107	97	89	71	364	390
Production and storage	17	22	19	18	17	76	88
Transmission	7	5	3	3	1	12	19
Distribution	68	70	70	62	50	252	260
General	6	10	5	6	3	24	23
Total Industry-Total	1,350	1,195	1,152	798	770	3,915	5,077
Production and other storage	189	96	86	72	73	327	597
Transmission	680	618	571	263	268	1,720	2,765
Underground storage	44	50	24	27	13	114	155
Distribution	383	382	427	393	381	1,583	1,369
General	54	49	44	43	35	171	191

Court Gas Ruling Asked

The Supreme Court has been asked to rule on whether a state minimum price applies to gas that has been processed.

The case was brought by Natural Gas Pipe Line Company after an Oklahoma court ruled it must pay 7 cents per mcf state minimum on dehydrated gas it buys from Panoma Corporation. After buying the gas from Panoma, the company routes it through its own compressor station and then back through Panoma facilities, where it is stripped before being piped to Midwest markets.

Natural claims it is not actually buying wellhead natural gas but, in effect, purchasing processed gas. The Oklahoma State Commission ruled otherwise, and has been upheld by the state court.

Oil's Safety Record Improves

Oil workers employed by member companies of the National Safety Council had a safer year in 1953, as did most employes in other industries.

Thirty-four of the 40 basic industry classifications listed by the Council reduced their frequency rates and 24 reduced severity rates. The average accident frequency rate for employes in all industries submitting company reports to the Council, based on the number of disabling injuries per million man-hours, was 7.44 in 1953, a reduction of 11 percent from the year before.

Petroleum's frequency rate was 9.00, a commendable 7 percent drop from the previous year. Oil's severity record was worse, going up 4 percent to 1.08, compared with .83 for all industries reporting to the Council.

Texas Allowable Again Cut

Texas took another reluctant right-hand turn on its crude production valve last month, but not without a long look around at what others are doing to ease the surplus.

The Texas Railroad Commission trimmed the August allowable by 121,642 barrels per day from the average of 2,842,746 barrels per day in the week ended July 10, bringing the total cut since April to nearly 400,000 barrels per day.

The new quota of 2,721,104 barrels per day is based on a 15-day pattern for most of the state. Shell Oil Company recommended a continuing 16-day pattern, but the others followed the lead of Humble Oil & Refining Company in urging the reduction to 15 days.

The process of reducing the allowable was accompanied by some pointed demands that other areas and branches of the industry cooperate to ease the situation. John Edwards of The Texas Company noted under questioning that all producing states except Texas and those in

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the Rocky Mountain area continue to fill a greater share of U. S. market demand than their respective reserves would justify.

Chairman Ernest O. Thompson had a few words to say about refineries built for security purposes on a fast tax write-off basis, at the federal government's request.

"These refineries were put on stream to test," he observed. "They've been reluctant to take them off, although they were built for use on a standby basis."

The commission plans to ask all companies for a report by next month on nominations to buy in each state, on allowables and on actual production.

T-H Change Proposed

Over-all revision of the Taft-Hartley Law has been considered dead for this session of the Congress, but there was a belated attempt late last month to push through one of the two changes favored by the President.

House Labor Committee Chairman McConnell (R., Penn.) introduced a bill dealing with a provision of the law that says workers striking for money gains may not vote in NLRB-supervised representation elections. Unions call this a union-busting feature, claim that an employer whose workers strike for more money could hire replacements for the strikers and then ask the National Labor Relations Board for an election decertifying the election. The replacements might then vote against the union.

The President has asked, and the McConnell bill provides, that this provision be altered so as to prohibit an employer from getting a decertification election for a year after a start of an economic strike and prohibit any other union from getting an election for four months after the strike starts.

The other change which has been wanted by the President would make employers, as well as union officials, subject to the non-Communist affidavits provision of the present law. This change would be taken care of in an anti-subversive bill being studied last month by the House and Senate Judiciary Committee.

Bargaining Not Necessary

The National Labor Relations Board got into the public prints a second time last month when it ruled, in effect, that the law doesn't require a man to take his hat off to somebody who's trying to club him over the head.

Companies don't have to bargain with unions that are their competitors in business, NLRB decreed in a dispute, first of its kind, between Bausch & Lomb Optical Company of St. Louis and the CIO Optical and Instrument Workers.

The board held that a union "cannot perform its statutory function as a bargaining representative if simultaneously it is an immediate business competitor of the particular employer whose employes it purports to represent." The board made it clear, however, that it was in no way condemning the spreading practice of unions investing in business.

Union Merger Seems Likely

The Oil Workers International Union may become a much more potent bargaining agency this month despite the near-failure of its campaign to date to join with independents in forming a new organization.

Rank and file committees of Jack Knight's CIO-affiliated OWIU, which claims to represent 130,000 industry workers, will meet August 9 in Washington with representatives of the 70,000-member CIO United Coke, Gas and Chemical Workers to discuss a merger.

Knight's effort to bring about a marriage of the CIO affiliates does not mean, however, that he has abandoned the "Philadelphia plan" for merging with independent organizations to form a new million-man Oil and Chemical Workers Union. On the contrary, the merger to be discussed this month would give Knight a new talking point to rally the independents under his banner. And that the banner would indeed be Knight's there seems little doubt.

Two years ago there was an effort to merge OWIU and the United Gas, Coke and Chemical Workers, but it was beaten by the latter group's president, Martin Wagner, who correctly figured that the president of such a combine would be Knight, because of his larger membership. Wagner has now been succeeded by Elwood Swisher, who has indicated his willingness to step aside in the event the merger is realized.

Ike Enters Tanker Dispute

The administration's determination to prevent government competition with private enterprise wherever possible was again evidenced last month when President Eisenhower aired his views on the hotly debated matter of tankers for the military.

The Senate has passed a bill providing for long-time charter of privately-built tankers, but the House changed it to call for government construction of 20 such vessels at a cost of approximately $150 million.

It appeared that the Senate version would win out after President Eisenhower declared he favors private construction with long-term charter arrangements.

Offshore Bonus Is Record

The oil industry has now paid bonuses of $66,152,432 for leases on 1,839,932 Gulf acres off Louisiana and Texas.

The Louisiana Mineral Board last month granted leases on state tracts totaling 44,-807 acres for $15,356,333.

This brought the total acreage under lease off Louisiana to 1,188,469 and the total bonus to $28,352,187.

For rights off Texas the oil companies have paid $37,800,245 for 651,463 acres.

One of ten bids on one offshore tract set a Texas-Louisiana record. Shell Oil Company bid $3,250,000 for a 3750-acre tract in Block 17, East Cameron area.

Highest previous bid had been Gulf Oil Corporation's $3,065,880 last December for a 5760-acre tract off Nueces County, Texas.

Heavy Investments In Oil

Oil is one of the three major U. S. industries whose shares are most widely held by 175 American investment companies with combined assets exceeding $5.5 billion.

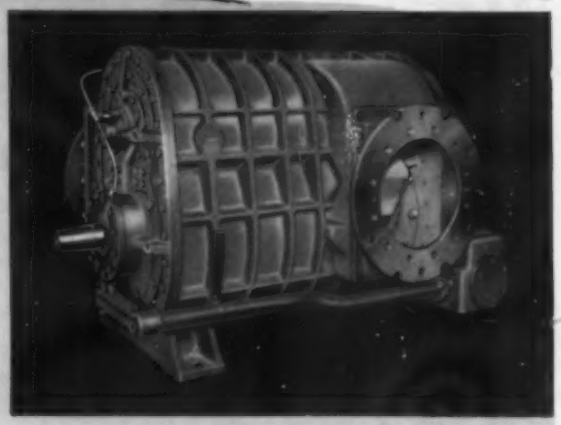
That fact is disclosed in the 1954 edition of "Investment Companies," issued annually by Arthur Weisenberger & Company, members of the New York and American Stock Exchanges.

Investment Companies say the oil industry shares held by the investment companies amount to 16 millions, with a value of $723 million. Of the other two leading industries, chemical has 5,100,000 shares with a value of $284 million, and utilities, 29,200,000 shares with a value of $950 million.

Tidelands Tiff Denied

Both the Justice and Interior departments refused to go along with published reports last month that they were at odds over how far Texas' rights to offshore lands extend into the Gulf.

Both denied that Justice was angry because Interior insisted on a 10½-mile limit instead of the three-mile limit said to have been fixed by Justice. A Justice spokesman said the department had not been in touch with Interior on the matter. This was backed up by two Interior officials. Acting Solicitor J. Ruel Armstrong said "no firm policy has been worked out; it's all in a state of flux." Acting Secretary of the Interior Ralph A. Tudor chimed in that, in any event, Interior supports the President's view that Texas is entitled to 10½ miles under the Tidelands Law. "It is not anticipated that any area within the three-league limit will be offered for lease by this department in connection with the proposals for leasing which are now being advertised," he declared.



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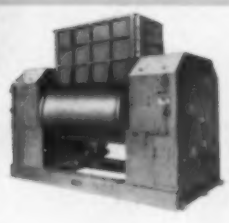

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HOT DOPE

Straight from the Kettle on PIPE PROTECTION

★

By Boyd Mayes

• Got strung out in a confab with a friend the other day about saving money. Saving's an interesting subject to us, because that's our business since our job is saving pipe by giving it the "forever" treatment before it goes in the ground. An old darkey named Uncle George Washington Jones up in the Piney Woods used to have a funny slant on saving. He lived in a tumbled down shack and raised corn for a living. He had a hound dog, a shot gun, a good disposition and a wide reputation for shooting crows. But he didn't call it that. He called it his SAVINGS BANK. He figured each crow ate a hundred dollars worth of corn in a season, and lived to eat ten seasons of his corn if let be. So, every time he shot a crow he marked up a one thousand dollar "deposit" on his rickity shed. No telling what Uncle George Washington Jones' balance was last time we heard of him, but he must have considered himself pretty rich. Maybe the old fellow had something. Come to think of it, if we had all the money we'd saved the pipe line industry by PUTTING PERMANENCE IN PIPE that moves crude oil, natural gas, and finished products from here to there we'd make Uncle George Washington Jones look like a crop failure.

MAYES BROS.

HOUSTON, TEXAS

Pipe Line Men

IN THE NEWS

C. B. Lester, chief engineer of **Mid-Valley Pipeline Company,** has gone to Paris, France, where he will be working on special assignment with the Joint Construction Agency, Department of the Army, for six months.

C. B. Lester

As a consultant to the Joint Construction Agency of the U. S. European Command, Lester will render technical counsel and engineering advice on military petroleum projects in France and other free nations on the continent involving tank farms, pipe lines, unloading docks, terminal facilities and allied installations being built under the jurisdiction of the U. S. European Command.

•

Hugh E. Dischinger, formerly general superintendent of **Shell Oil Company's** products pipe line department, has been promoted to the post of manager to succeed **Sidney S. Smith.** Smith retired recently after 30 years of service with the company.

Dischinger joined Shell in 1924 and became general superintendent of products pipe lines in 1948. He will be succeeded by **Vern K. Leonard.**

•

The board of directors of **Sinclair Pipe Line Company** has created an executive committee of five members, three of whom are directors, to study and make recommendations on operations, policies, budgets, organization and coordination.

Chairman of the committee is **R. C. Bearden,** a vice president of the company. Other members are **L. B. Moon** and **G. M. Johnson,** both vice presidents; **E. H. Unruh** and **H. J. Amend.** Ex officio members are **R. J. Tibbetts,** chairman of the board, and **William H. Morris,** president of the company. **H. W. Bailey** will be secretary of the committee.

Millard K. Neptune, manager of the newly formed **Egyptian-American Oil Company,** has announced appointments to key positions in the company.

Egyptian-American will operate and manage the 75,000-square-mile petroleum concession recently granted by the Republic of Egypt to Conorada Petroleum Corporation. The concession will be assigned in the near future to subsidiaries of Continental Oil Company, The Ohio Oil Company, Cities Service Company and Richfield Oil Corporation.

The Continental subsidiary, Egyptian-American, will be the operating company for the group.

William F. Penniman, who formerly represented Conorada in Cairo and who negotiated the concession, will join Egyptian-American as assistant manager in charge of financial and governmental affairs. **James S. Royds,** presently Rocky Mountain region exploration manager for Conoco, will become exploration manager of the Egyptian venture.

Robert Blair of Salt Lake City, division geologist for Continental, will become chief surface geologist for Egyptian-American. **Sam Leonard,** Houston, assistant director of Continental's employe benefits division, will transfer to Egyptian-American as controller. Chief geologist for the new organization will be **Don B. Eicher,** who presently is supervisor of exploration for Arabian-American Oil Company in New York.

All of the five key men, along with Neptune, will make their headquarters in Cairo.

•

Ralph F. Moore has been elected president and director of **Platte Pipe Line Company** to succeed **Millard K. Neptune,** who has become manager of Egyptian-American Oil Company.

Other appointments within Platte Pipe Line include the promotion of **Howard C. Vanhooser** to co-ordina-

NEW CATALOG D

. . . contains complete descriptions, specifications and illustrations of Tracerlab's nuclear instrument, radiochemical and laboratory accessory line . . . the largest and most comprehensive of any manufacturer in the nucleonic field. Included are the new Autoscaler, available in seven models; the Automatic Flow Counter; a newly redesigned Laboratory Monitor; several new Geiger-Mueller tubes, including the TGC-20 Well Geiger Counter; new sources; as well as many new chemicals and accessories. A unique section of this catalog describes such custom equipment as the Liquid Scintillation Detector, MEW Counter, Multichannel Analyzer, Argon Gammagraph, Robot Scaling Equipment with Robot Sample Changer, Facta Printer and Automatic Chromatogram Scanner, a Beta Ray Spectrometer, Four Pi Counter and special air monitors. If you haven't received a copy, please request one.

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Westinghouse Air Brake Co. pneumatic devices—valves, relays, actuators, cylinders, filters, compressors—are made for each other; they form an efficient smooth-working team that assures *accurate* control of throttles, clutches, and brakes on drilling rigs.

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125,000 Feet - 12¾ O.D. .375 Wall, 49.56 lb. Lapweld

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tor of oil movements in the newly created oil movements department. **Lauren L. Faucett** has been promoted from general accountant to chief accountant of the company.

•

Ammon O. Ackroyd, practicing attorney in Edmonton, Alberta, has been appointed full-time executive secretary of the **Canadian Pipe Line Contractors Association.**

The association was founded in Edmonton in April by 14 contractors. Officers are **E. W. Costello,** president; **G. A. Wilkinson,** first vice president; **R. K. Banister,** second vice president; and **W. Tesluck,** treasurer. Offices are in the Northern Hardware Building in Edmonton.

•

W. R. Flanagan has retired as superintendent of the right-of-way department of **Sinclair Pipe Line Company,** after 38 years with Sinclair. **Fred A. Crane,** a veteran pipe liner with the company, took over the position after Flanagan's retirement.

•

H. C. Price Company's quarterly publication, *The Tie-In,* has a new editor, **Richard Hoyt.** Former editor **David J. Kerr** left to work in the Public Relations department of **Gulf Interstate Gas Company.** Hoyt came to Bartlesville to join the Price Company after working in Chicago for a newspaper advertising representative firm.

Kenneth G. Pearce has joined **Tennessee Production Company** as ga... gasoline superintendent. A graduate of the United States Naval Academy, Pearce began his oil industry experience in 1934. Before coming to Tennessee Production, he was assistant manager of **McKamie Gas Cleaning Company** of Magnolia, Arkansas.

Kenneth G. Pearce

•

Karl Feldman, director of engineering for **Sinclair Pipe Line Company,** has been named manager of the **Arapahoe Pipe Line Company** at Hutchinson, Kansas.

Arapahoe is a jointly owned firm by Sinclair and Pure Oil Company to construct a pipe line from Merino, northeast Colorado, to Humboldt, Kansas, where it will tie into the Sinclair main line for Chicago.

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water cans and coolers
GOTKOOL WATER CAN
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Insist on the Genuine
Gott
WATER COOLER
H. P. GOTT MFG. CO.
WINFIELD, KANSAS

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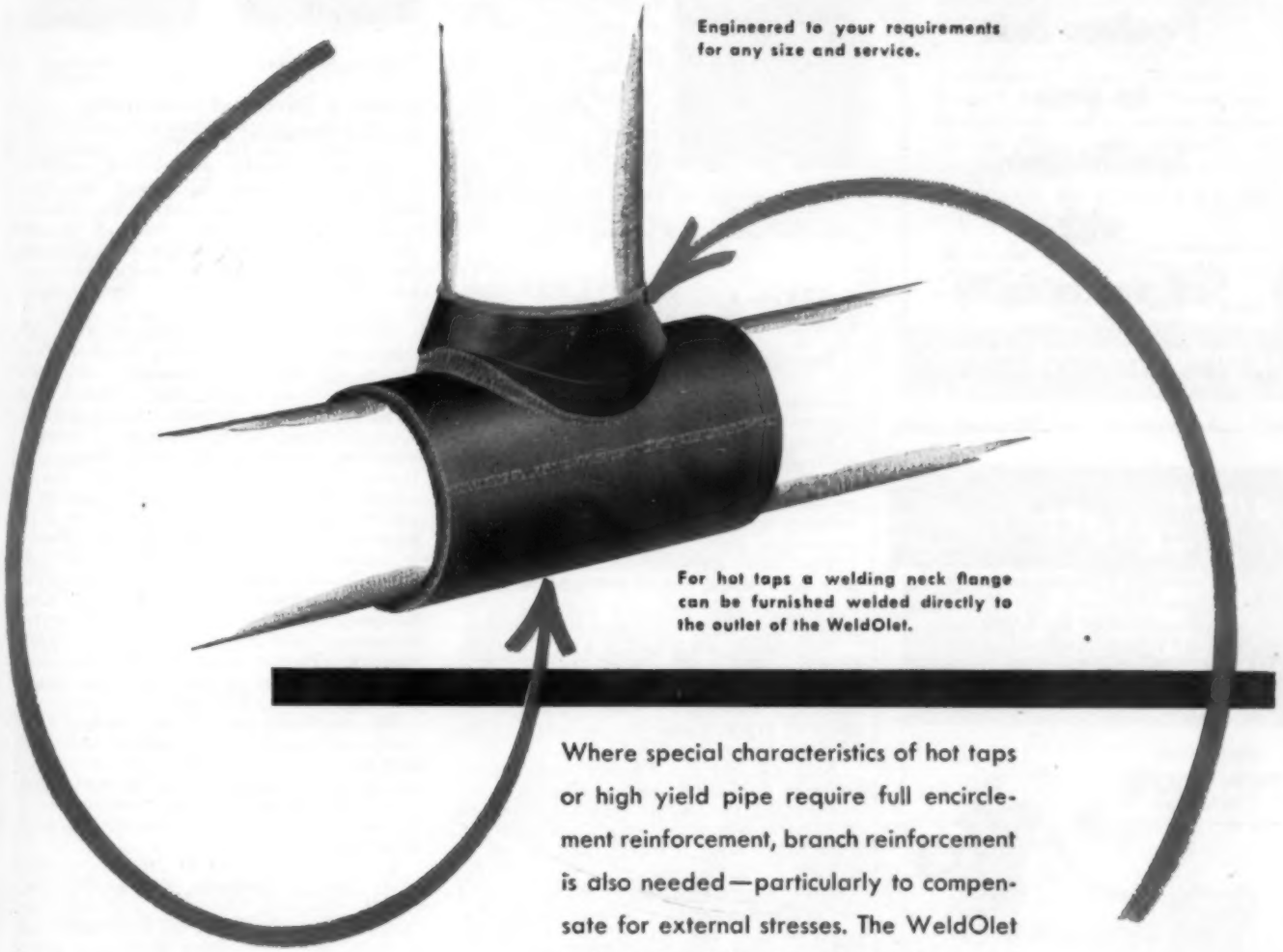
New WeldOlet Split Tee for hot taps and new construction

Assembled and Ready for Field Installation, the WeldOlet Split Tee "Nails Down The Lid" where Full Encirclement Reinforcing is Needed.



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For hot taps a welding neck flange can be furnished welded directly to the outlet of the WeldOlet.

Where special characteristics of hot taps or high yield pipe require full encirclement reinforcement, branch reinforcement is also needed—particularly to compensate for external stresses. The WeldOlet Split Tee satisfies this combined requirement in the most economical manner.

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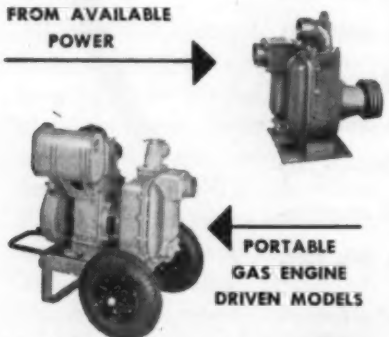

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What's Happening

Beaird Names C. E. Russell Assistant Works Manager

C. E. Russell, who has been manager of the Machining division, has been promoted to assistant works manager of The J. B. Beaird Company, Shreveport.

C. E. Russell

Russell will be in charge of all manufacturing departments, including machining, fabricating, stores control and maintenance.

Before going to Shreveport, Russell was assistant general manager of the Turner Brass Works in Sycamore, Ill. for three years, where he directed all production, estimating and tooling work.

Tube Kote Adds Equipment To Pipe Manufacturing Division

Both flexible and semi-rigid plastic pipe are now available from Tube-Kote Inc., Houston firm that has pioneered in non-corrosive plastics since 1939.

With the recent addition of the only electronically controlled plastic extrusion machine in the Southwest, Larry Heinen, president of Tube-Kote, said that the oil industry now has a Houston source for this economical pipe.

The new thermo-molding machine is only part of the initial $100,000 worth of equipment Tube-Kote has installed to organize its new pipe manufacturing division.

Now producing TK-202, a flexible plastic pipe made of polyethylene, and TK-404, a semi-rigid pipe made of cellulose acetate butyrate, Tube-Kote plans eventually to make all types of plastic-composed pipe for oil field use and other industries.

Both TK-202 and TK-404 are corrosion resistant, rust-proof and rot-proof. TK-202 is adaptable for use as surface water lines, drinking water lines, farm irrigation systems, water wells, jet wells, and for use in dairies, oil fields, and other industries. TK-404 is produced especially for oil field use and is not affected by sour or paraffin laden crudes, salt water, various acids, alkalies, salts, hydrocarbons, and other fluids.

Pittsburgh Coke & Chemical Opens Office in Dallas

A new divisional sales office of the Protective Coatings division, Pittsburgh Coke and Chemical Company has been opened in Dallas. O. E. McCullough, Jr. has been appointed to this office in charge of cold coating sales.

Before being recalled to service, McCullough was attached to the Pittsburgh office. A native of Dallas, he had his own oil business and formerly was director of personnel and sales manager of Stacey Dresser Engineering Company in Cleveland, Ohio.

Rodney S. Durkee

M. E. Montrose

Rodney S. Durkee of Lane-Wells Elected President of PESA

Rodney S. Durkee was elected president of the Petroleum Equipment Suppliers Association at the organization's nineteenth annual meeting, held at Manoir Richelieu, Murray Bay, Quebec, Canada, June 28-July 1. Durkee is president of Lane-Wells Company, with headquarters in Los Angeles.

Other newly-elected officers are vice president, M. E. Montrose, Hughes Tool Company, Houston; treasurer, Wharton Weems, Vinson, Elkins, Weems and Searls, Houston; assistant treasurer, Leroy Jeffers, Vinson, Elkins, Weems & Searls, Houston; executive secretary, H. R. Safford, Jr., Houston.

The following were elected to the executive committee: Eastern District, Lloyd N. Lanphere, Ajax Iron Works, Corry, Penn.; Mid-Continent and Rocky Mountain District, Rainey Elliott, Jones & Laughlin Steel Corporation, Supply division, Tulsa; Southwestern District, George O'Leary, Houston Oil Field Material Co., Inc., Houston; Pacific District, Ott Hammer, Dresser Operations, Inc., Security Engineering Division, Whittier, Calif.

The executive committee together with the president and vice president comprise the operating committee. The executive committee is composed of chairmen of the boards of directors from the districts, each of whom is elected by board members within his own district.

The guest speakers at the convention were: John F. Skillman, deputy director, ACME Division, Business and Defense Services Administration, U. S. Department of Commerce; Dr. John Davis, associate director, Economic Branch, Department of Trade and Commerce of the Canadian Government.

Saum and Marston Receive Posts With Taylor Forge & Pipe Works

Taylor Forge & Pipe Works, Chicago, has named George Saum as manager, Taylor Forge Aircraft Products division. T. E. Marston becomes general sales manager of this division.

Facilities in the Taylor Forge Gary plant augment those of the other Taylor Forge plants and include the world's largest forging hammer of its type now in operation, a large counterblow hammer and other hammers, large presses, and rolling equipment.

AMONG SERVICE AND SUPPLY MEN

Wiliam G. Young

E. L. Farrell

Nordburg Manufacturing Company Appoints Two District Managers

E. L. Farrell has been appointed district manager for the Milwaukee territory and William C. Young district manager, Great Lakes Territory, of Nordberg Manufacturing Company. Both districts will have headquarters at Nordberg's main office and plant at Milwaukee.

The Milwaukee Territory which Farrell will serve includes the states of Wisconsin, Minnesota, Iowa, and northern Illinois. Young's assignment to the Great Lakes Territory carries the responsibility for serving customers in Michigan, Indiana, Ohio, western Pennsylvania, and Eastern Kentucky.

During their last three years at Marquette University, Farrell and Young served Nordberg as co-op students spending half time at school and half time working in the Diesel engine erection and test department.

In 1943 Farrell was assigned to the Sales department, Heavy Machinery Division and Young entered the U. S. Navy. After the war, Farrell and Young were appointed sales engineers handling special assignments out of the Milwaukee office. In 1951 Young was transferred to Nordberg's Washington, D. C. office, where he served in a similar capacity until his appointment as district manager, Great Lakes territory.

Perrault Equipment Company Announces Appointment of Maddox

Mel Maddox, with seven years' experience in the pipe line industry, has joined Perrault Equipment Company.

Maddox was formerly associated with Pittsburgh Coke and Chemical Company and Reilly Tar and Chemical Corporation. He came to Tulsa first in 1952, was recently transferred to Atlanta, but returns to Tulsa in his new position.

Hercules Motors Corporation Opens New California Branch

Hercules Motors Corporation has opened a new Los Angeles branch to serve the West Coast area. Facilities of the new factory branch include a salesroom, modern offices, a parts department and machine shop with truck and railroad loading docks.

Jaeger Named Publicity Manager Of Bucyrus-Erie Company

Martin B. Jaeger has been promoted to publicity manager of Bucyrus-Erie Company to succeed Emory M. Heuston, who left to join an industrial advertising agency. Heuston had been assistant publicity ager since 1945.

Jaeger, who has been assistant publiity manager for three years, joined the company in 1943. In his new post Jaeger will have responsibility for direction of the company's product advertising and publicity programs.

Martin B. Jaeger

Hamer Oil Tool Changes Name to Hamer Valves, Inc.

A change of the company name from Hamer Oil Tool Company to Hamer Valves, Inc. has been announced.

Leland Hamer, president, indicated the change was made to more clearly identify the company with the products it manufactures. Hamer Valves, Inc. is at 2919 Gardenia Avenue, Long Beach 6, Calif.

Franklin Supply Company Elects Officers; Opens New Stores

Jene Harper, Chicago, was elected president of Franklin Supply Company recently. Other officers include Roy Wood, Chicago, vice president; Leland Strouse, Dallas, vice president; Lawrence Harper, Tulsa, vice president; Albert J. Mitchell, Chicago, treasurer, and William P. Quan, Chicago, secretary.

Harper announced the board's decision to establish two new oil field supply stores at Fort Morgan, Colo., and Newcastle, Wyo. The appointment of William Kerin to the newly-created post of general store manager was approved. Kerin's position as store manager at Oklahoma City was filled by Jack Carroll.

It was also announced that Franklin Pipe and Supply, Ltd., Canadian subsidiary, is opening a sales office in Calgary, Alberta.

Gardner-Denver Company Elects John W. Gardner Director

John W. Gardner has been elected a director of Gardner-Denver Company.

Gardner is a graduate of the Missouri School of Mines and served in the U. S. Navy during World War II. He joined the company's Los Angeles Sales division in 1945 and in 1951 was transferred to its executive offices in Quincy. At present, Gardner is employed in the engineering development section, relative to new industrial applications for Gardner-Denver's products.

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The Centrifugal Casting and "Heat Tensioning" methods used by France have proved: here are Piston Rings that assure you longer life and efficient oil control with no warping or loss of tension in service.

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JET-LUBE VL-5 VALVE LUBRICANT

WITH MOLY-DISULPHIDE

High temperature, non-melting silica base valve lubricant with low friction moly-disulphide. Use JET-LUBE VL-5 on valves that are hard to turn. Resistant to hydro-carbons, water, acids, sulphur and alkalies. Batch controlled. Fully guaranteed.

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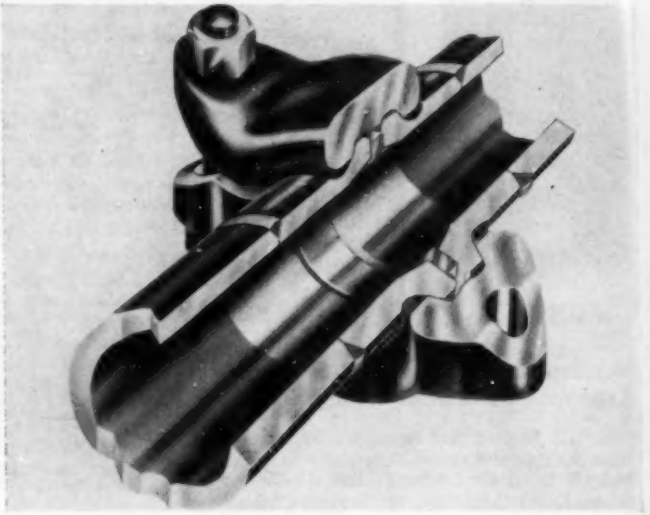
What's New in Equipment

for the Pipe Line Industry

All parts are fully interchangeable and re-usable in this new . . .

One-Specification Piping Connection



A new connection has been designed which offers industry the first "one specification" connection for all piping applications and pressure ratings. It is a "one specification" connection because it requires no selection of gaskets, facings or bolts, all parts being fully interchangeable and re-usable. Developed by Gray Tool Company, with patents applied for and registered under the trademark GRALOC, the connection employs a two-bolt clamping principle and a stored energy seal.

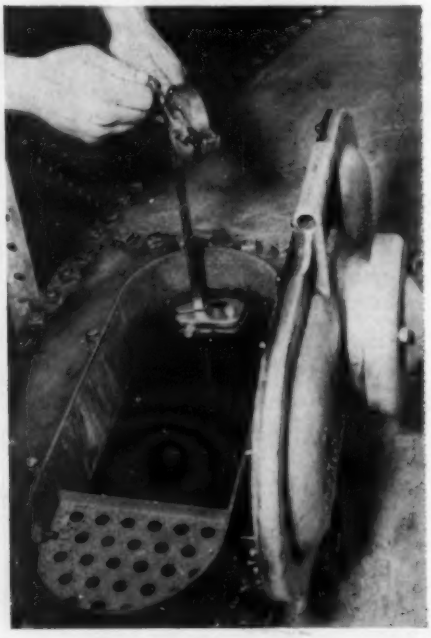
A steel sealing ring, having flexible lips and a rigid rib fits between the steel connecting hubs. The angle of the tapered lips of the ring is less than the tapered seats of the hubs. As the joint is made up, the lips of the seal ring conform to the seats of the hubs, thereby utilizing the elasticity of the steel as a source of stored energy to effect and maintain a positive seal. Internal line pressure serves to increase the effectiveness of the seal without creep or movement.

Instead of the usual bolting, GRALOC uses a two-piece steel clamp which works against tapered shoulders on the connecting hubs. The clamp is held in place by two high-strength steel bolt studs made to ASA specifications.

The connection will far exceed the pressure limits and bending moments in the heaviest wall pipe. Because it is of all steel construction, expansion or contraction does not affect the seal. It is leakproof when used with any fluid at any temperature the pipe is capable of carrying, including light hydrocarbons, steam and even low molecular weight gases.

Standard GRALOC connections are made in three styles: butt welding, slip-on and threaded, in a range of sizes from 1½-inch to 12-inch for all standard weights from schedule 40 through schedule 160 or XX strong. They can be made for Super Pressure applications and of heat and corrosion resistant material.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.



Gauge Line Wiper

A new device for saving time and avoiding hazards from oil blowing over tank deck and walk which eliminates frequent cleaning and painting has recently been placed on the market. It is a metal and synthetic-rubber combination designed compactly into a gauge line wiper. It is easily installed in the hatch hole of the tank by means of a rigid bracket with slotted hole for hatch bolt and adustment. The gauge line is reeled in through the wiper, which effects thorough cleaning of both line and plumb bob.

The wiper does not interfere with gauging or thieving operations and it is out of sight when the hatch cover is closed, yet is always in position to clean the line and bob after the tank has been gauged. Thumb screw is provided for adusting the insert compression rubber to obtain maximum wiping action. The gauger never has to touch the wiper, nor does he have to handle the line while it is being reeled in.

The gauge line wiper has a guide which keeps line in place while being reeled in and wiped. Guide also acts as ground against static electricity.

The Grip-Tite gauge line wiper is manufactured by *Grip-Tite Manufacturing Company,* Marshall, Texas, and will be available through supply stores.

(This item supplements Grip-Tite Manufacturing Company data on page 1879 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Drillmaster

Ingersoll-Rand has introduced a new self-contained and self-propelled twin-drill rig designed to cut cost and speed operations on heavy-duty wagon drill type jobs. The completely integrated unit includes two hydraulic booms, two 10-foot wagon drill towers, two heavy-duty X-71-WD rock drills, a rugged crawler assembly and a 600-foot Gyro-Flo rotary compressor.

It is recommended for right of way construction on pipe line work, as well as for drilling rock in trenches.

The Drillmaster requires only two operators. Three wagon drills require a 600 cubic foot and a 300 cubic foot compressor to supply the necessary drilling air.

The unit weighs 28,500 pounds, utilizes two X71-WD drills with an 8-foot steel change. It will drill holes up to 18 feet 6 inches between centers. Moving speed is two miles per hour on the level and it will negotiate a 15 percent grade. The manufacturer also says that the Drillmaster provides a dependable self-propelled air power plant when needed for other uses.

(This item supplements Ingersoll-Rand data on pages 2411-2418 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Plug Valves

Two new balanced-type plug valves, the Hamer 10-inch and 12-inch are being manufactured by Hamer Oil Tool Company. Currently being produced in ASA 150-pound and 300-pound classes the new plug valves are available in carbon steel as well as other materials. Chain wheel attachments for overhead operation are available on both models. Intended for

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LUFKIN, TYPE N "HIGH SPEED"

ANY SIZE

3 TO 2000 H. P.

ANY SPEED

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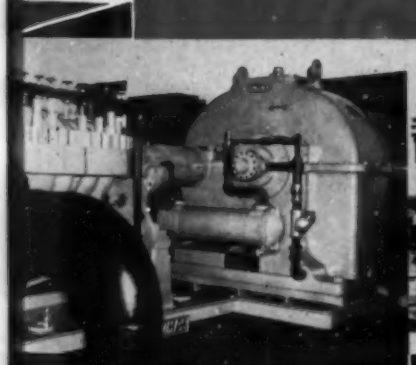
ANY RATIO

1 TO 1 TO 70 TO 1

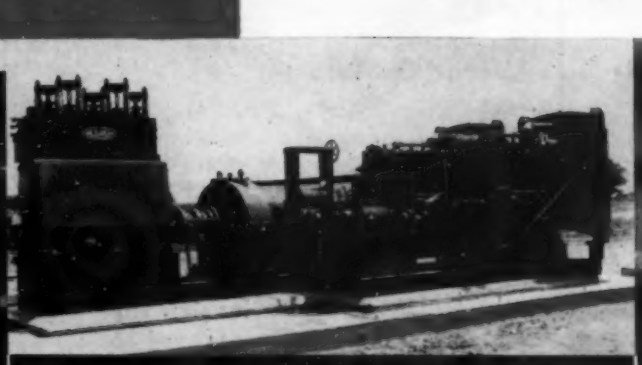
ANY JOB

WHERE SPEED IS REDUCED OR INCREASED . . . . . .

Eighty Different Sizes From Which To Choose



PIPELINE PUMP



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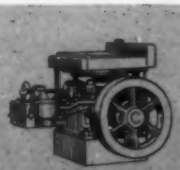
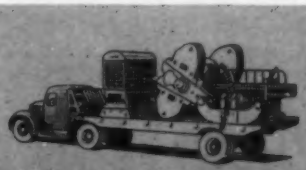


LUFKIN-COOPER-BESSEMER ENGINES



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Also for pressure vessel heads

Nominal pipe sizes 1" to 30"

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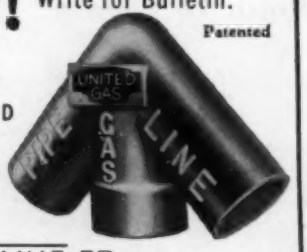

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general service involving high as well as low temperatures, these valves are gland packed. Packings can be changed under pressure while the line is on stream.

The new plug valves can be operated with or without lubricant. They are equipped with lubrication fittings through which an ordinary medium grade of grease may be applied to the packing and bearing surfaces. Valves are so designed that the lubricant fills the balance chambers first; grease will not enter the line unless an excessive amount is applied. Where lubrication is prohibited, these valves will operate effectively with the lubricator hole plugged.

(This item supplements Hamer Oil Tool Company data on pages 2057-2060 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Water Coolers

Recessed push-button faucets, flush mounted, are now available on all sizes of Gotkool water cans and water coolers, products of H. P. Gott Company, except 15- and 20-gallon sizes. This convenient, sanitary faucet, which is available at no extra charge, is easily accessible to workmen with large hands even while wearing gloves. The recess is pressed into the body of the container, thereby leaving no seam to lose insulation efficiency. The previously available Gotkool water cans and water coolers with the extended type faucets are still available.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

AC and DC Welding

An important new development in arc welders is announced by Harnischfeger Corporation, Welding division. The P & H model DA-200 in a single machine provides both AC and DC welding. A flip of the switch gives the desired welding current. It is possible to change from one current to the other while welding to take advantage of the characteristics best suited for the work. This assures best possible welding results while speeding the job and cutting costs.

Now in volume production, this new P & H Welder has an AC welding service range of from 7 to 275 amperes and 7 to 200 amperes DC. It operates on 220/440 volt, 50/60 cycle current, single phase. It is equipped with P & H Dial-lectric control which provides instantaneous heat selection. For remote control, the radio-type dial may be taken to the work. There are no moving parts in the machine.

(This item supplements Harnischfeger Corporation data on pages 2064-2066 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Tractor Shoes

Crawler tractor owners using their machines on rock and other hard surfaces with the resultant heavy wear may now purchase double grouser track shoes for Caterpillar D8 tractors.

In areas where the tractor is working in blasted rock, the track shoes suffer from extreme wear due to track slippage and also from bending which causes ultimate failure. The double grouser track shoe is designed for a considerably greater resistance to bending, something in the order of 300 percent or more. Resistance to bending is achieved by having two parallel grousers lower in height than the single grouser shoe but wider. Also the body of the shoe is made thicker, all at the expense of added weight but designed for the best usage of material to gain the greatest possible resistance to bending.

The second grouser at the mid-section of the shoe provides protection to the track shoe bolt heads, so that they are not subjected to pounding which causes loosening of the bolts. The grouser tips are wide and extremely hard, which increases the wearing area over the single grouser more than three times.

It is obvious that such a design of shoe is aimed at a particular type of service where the footing creates severe bending stresses in the track shoe and where the rate of wear is extremely high due to track slippage and tearing of metal away from the shoe in extremely rocky footing. It is also obvious that this design of shoe is not comparable to the single grouser shoe under normal soil conditions where the most important factor in the track shoe design is good soil penetration for maximum traction or drawbar pull.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

New Catalogs and Equipment Literature

Compressor Bulletin

Comprehensive engineering details of Cooper-Bessemer's newest engine driven compressor, the GMBA, are presented in a descriptive bulletin just released.

This bulletin, showing the latest Cooper-Bessemer developments in mechanical scavenging of two-cycle engines by rotary blowers, gives performance charts, diagrams and resulting increases in engine power and fuel saving. Cutaway drawings provide complete engine details as well as installation and operational data.

To get a copy, circle **No. E8** on Readers' Service Card, last page this issue.

Welding Book

The latest developments in the science of welding aluminum are described by the Aluminum Company of America in the completely new book, "Welding Alcoa Aluminum."

After an introductory section of this 176-page book explaining characteristics of welded joints, the book describes how to select the best method for welding aluminum. This discussion includes the factors that influence aluminum alloy selection for a welded structure.

Comprehensive descriptions of the methods for aluminum welding are presented in the six chapters that follow. The following welding methods are included in these chapters:

- Inert gas shielded metal arc welding with both tungsten and consumable electrodes.
- Spot and seam welding.
- Flash welding.
- Metal arc, carbon arc, atomic hydrogen and gas welding.

Welding of aluminum castings is explained and is followed by a complete discussion of pressure welding methods and applications. One of the most important contributions of the new welding book is the section on performance of aluminum welds. This discussion offers the readers the extensive experience of Alcoa's research facilities in testing weld performance. In addition, methods are outlined for designing parts with welded joints.

In the final section are 32 comprehensive tables giving data on welding aluminum. These tables include information such as the physical property of aluminum alloys, alloy composition and strength of certain type welds. They also provide useful information about welding conditions.

To get a copy, circle **No. E9** on Readers' Service Card, last page this issue.

Replacement Catalog

Replacement parts for any make or model of drag line bucket are described in a new catalog just released by Electric Steel Foundry Company. This catalog contains information of value to the owner or operator of any make or model of drag line bucket. This 28-page, two-color catalog is indexed and tabbed for speedy reference to parts. Part specifications are presented in groups; for example all of the hoist chain parts are together.

In addition to the catalog section, there is information and hints on such items as how to determine proper drag chain link, drag and hoist chain specifications, and maintenance tips and alloy recommendations. Also included is information of several new products such as the new ESCO "Spring-Lock" hinge repair links for drag chains.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Maintenance Cleaning

How-to-do-it charts based on actual in-plant maintenance procedures, are a feature of the new "Plant Maintenance Cleaning Guide" recently published by Oakite Products, Inc.

Designed for quick reference, the charts list recommended cleaning materials, methods of application, concentrations and temperatures for such specific operations as cleaning and treating the water, air-conditioning and refrigeration units; cleaning compressors and condensers; de-scaling diesel water jackets and water-cooled furnaces; cleaning floors, oil heaters and coolers; stripping paint from machinery and transformers; and removing rust.

In addition, the booklet describes Oakite cleaning materials, Oakite solution lifting steam guns, and Oakite's hot-spray unit.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

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Advertisers' Index

• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current 19th (1952-53) edition of The Composite Catalog of Oil Field and Pipe Line Equipment.

A

Aero Service Corp. 8
Aerofin Corp. 93b
• The Aldrich Pump Co. 83
Allen Cathodic Protection Co. 112a
• Allis-Chalmers Manufacturing Co. 22-23
Alston Manufacturing Co. 93c
• American Sand-Banum Co. 104a
American Telephone & Telegraph Co. 72

B

Bakelite Company, Div. Union Carbide and Carbon Corp. ..... 25 and 59
The J. B. Beaird Co. 71
Bonney Forge & Tool Works 105
• Bucyrus-Erie Co. 18

C

CRC Engineering Co. 2
E. L. Caldwell & Sons 100b
Caterpillar Tractor Co. 9
• Clark Bros. Co. 54-55
• The Cleveland Trencher Co. 115
• Continental Motors Corp. 89
• Crane Co. 29
• Cummins Engine Co. 30-31

D

DeLong Corp. 35
Dowell Incorporated 77
• Dresser Operations, Inc. 54-55

F

Fleet-Line Co. 110b
France Packing Co. 107a
• Frontier Industries, Inc. 87

G

• Gaso Pump & Burner Mfg. Co. 116
• H. P. Gott Manufacturing Co. 104c
Greenhead Sling & Supply Co. 100a
• Gulf Publishing Co. 86b
Gunite Concrete & Construction Co. 110c

H

• Hercules Motors Corp. 84
Houston Contracting Co. 93a
Humboldt-Chicago Pipeline Project ..... 90c and 104b

J

Jefferson Chemical Co. 10
Jet-Lube, Inc. ..... 90d and 107b

K

Kaiser Steel Corp. 32
• Kinzbach Tool Co. 6

L

• Lufkin Foundry & Machine Co. 109

M

M-R Pipe Line Construction 106a
Mack Trucks, Inc. 21
Macwhyte Co. 33
• Manzel, Division Frontier Industries, Inc. 87
Marine Products Co. 106b
Mayes Bros. Inc. 102
The Mercoid Corp. 95a

N

National Bank of Commerce 85
• National Tank Co. 79
• W. C. Norris, Manufacturer, Inc. 19
North American Aerial Surveys Corp. 86a

O

• Oil Well Supply Division United States Steel Corp. 5

P

• Pelican Supply Co. 112b
Petroleum Electric Power Assoc. 11

R

Read Standard Corp. 101
• Republic Steel Corp. 27
• The Ridge Tool Co. 96
Roach Equipment Mfg. Co. 90a
• Rockwell Manufacturing Co. 81

S

Shand & Jurs Co. 12
Shell Oil Co. 24
• A. O. Smith Corp. 13
Southern Engine & Pump Co. 95b
Standard Oil Co. of California 28
Station Construction Co. 90b
• Steel Forgings, Inc. 110a

T

Texas Employers Insurance Assoc. 34
• Thornhill-Craver Co. 26
Tracerlab Inc. 103a
• Tretolite Co. 63
• Tube-Kote, Inc. 111

U

Union Carbide & Carbon Corp. ..... 25 and 59
• Union Wire Rope Corp. 14-15
United States Steel Corp. 5

V

The Vapor Recovery Systems Co. 97

W

• W-K-M Manufacturing Co. 17
Wadsworth Manufacturing Co. 92
Walworth Co. 20
• Waukesha Motor Co. 16
Westinghouse Air Brake Co. 103b
Weston Electrical Instrument Corp. 91

Y

The Youngstown Sheet & Tube Co. 7

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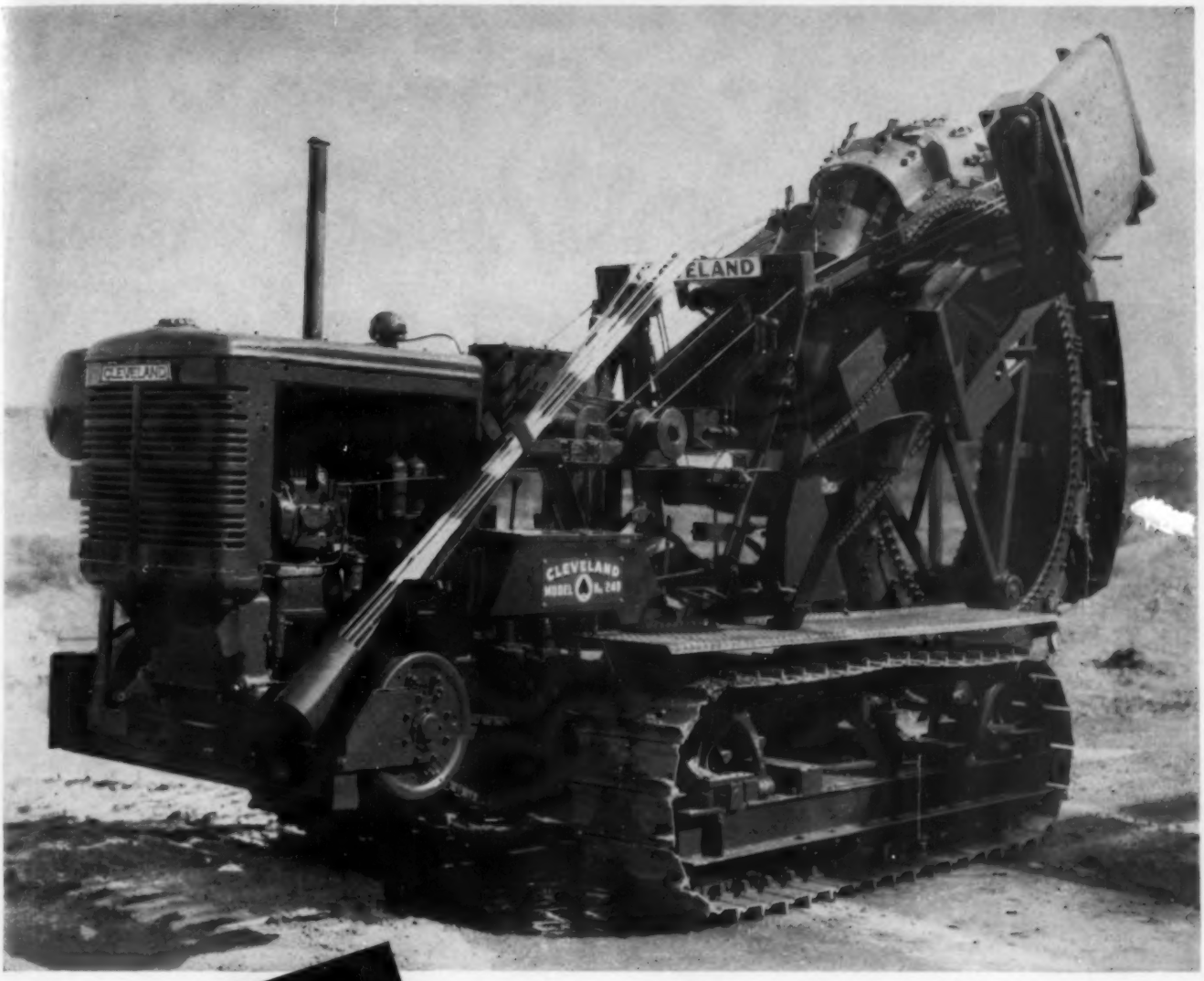

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